THE

Practical Teacher

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'Knowledge is proud that he has learned so much,
Wisdom is humble that he knows no more.'—COWPER.

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Health at School.

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XI.—PHYSICAL EXERCISE—*continued.*

THE VARIETIES OF EXERCISE.

WALKING, leaping, running, rowing, swimming. The muscles which are developed in each kind of exercise might be considered in this part of my subject, but the space at my command is insufficient for the purpose. I might also consider the natural varieties of exercise as brought out in cricket, fencing, football, rounders, rackets, tennis, fives, and even the more plebeian games of leap-frog, hop-scotch, blindman's buff, and the use of the skipping-rope. Each and all are useful in their ways, and should be encouraged in their season. Systematic physical education, by means of gymnastic exercises in which muscles are brought into use in rotation and according to scheme, is undoubtedly beneficial under certain circumstances and in crowded localities where it is impossible to have the use of a proper play-ground; but a school is not properly constituted which has not the use of an exercise ground in correspondence with the number of the pupils. The national games I have mentioned are far superior to any artificial system which has ever been laid down by authority. All that is required is, that exercise shall be brisk, and the respiratory muscles brought fully into action. Appetite is increased by it; more food is assimilated in a healthy fashion than can possibly be the case when no regular exercise is taken; the system becomes properly tired out, and at the end of the day 'nature's sweet restorer, balmy sleep,' gives that rest to the weary which 'nature's soft nurse' is ever ready to afford to those who follow her dictates and obey her behests. I may illustrate the value of systematic exercise by a circumstance which occurred at the Anerley School a few years ago. The school authorities had engaged a drill-master to drill the young urchins who are taken care of in that great establishment. The expenses of the school are paid for by the Boards of Guardians out of the poor-rates of three or four combinations of parochial authorities of some of the parishes on the south of the Thames. The fact of a drill-master being engaged to drill a set of pauper boys was too much for the rate-saving portion of the Guardians, and strong representations were made to the Board of Management against this apparently useless luxury, and as a consequence of the opposition of the paymasters, the drill-sergeant was superseded. Previous to his first engagement there had been great difficulty in the boys' dormitories. Mischief was constantly perpetrated in the night, bolstering and other amusements in the still hours were not uncommon, to the serious damage of the bed linen, night-dresses and other articles, in the dormitory. Coincidently with the introduction of the drill-master, this source of damage seemed to disappear. It revived soon after the dismissal of the drill-master, and then it struck the Chairman of the Board of Management that there was something more than a coincidence in this, that the two results had an alliance as cause and effect. The expense of repairs to bed furniture and night clothes was very much larger than the salary paid to the drill-sergeant. The cost of the one, upon close enquiry, was found to be more than three times the cost of the other. The Board determined to restore the drill-master as an experiment. By his return, quiet was obtained in the night to the occupants of the dormitories, and a serious loss to the managers prevented. The boys were properly tired out; even nightmare was comparatively uncommon under the new *regime*, sleep was sweet, and the boys no longer disturbed each other by horse-play at the wrong time.

The neglect of exercise is more marked in girls' schools than in those which are provided for boys, whilst females suffer in adult life even more than men from a neglect of its requirements. The restraint upon their freedom of motion, both by custom and the improper character of their dress, tends to increase the mischief; girls should exercise themselves quite as much as boys until they reach the age of twelve or thirteen, and there is no reason whatever why they should not be as active in their movements, and as energetic in their play as boys should be. Cricket, fives, rounder, and even leaping and swimming should be encouraged. Their dress should allow of this freedom of action, and prudish notions of such conduct being unfeminine should be put aside as contrary to health. When girls become young women,

and natural changes are taking place in their constitution, it may be time to change the form of exercise to something a little less boisterous; but rapidity of muscular movement, which rapidity should at times apply to all the muscles of the body, should be encouraged in girls at all ages. The use of the skipping-rope for boys, as well as girls, is to be encouraged, because it exercises all muscles equally, and does away with the tendency which is always present to take to one set of muscles more than another, and to throw the machine out of balance by developing the right side more than the left, or *vice versa*. I am in the habit of recommending parents when they find certain kinds of deformities to be threatening, to encourage their children to trundle a hoop with the left hand, the right being tied behind the patient; or to play at shuttlecock and battledore with the left hand, the right being similarly treated. This would be a very good kind of exercise to encourage in all schools, so that each set of muscles may be equally developed, and young children taught to use the left hand as much as the right.

TIME ALLOTTED TO STUDY.

The teacher should always bear in mind that long-continued occupation in any one direction is not good education, that excess of mental application is injurious to bodily strength, and that intemperance may refer to mental work, to bodily exercise, and the digestive functions, as well as to excess of liquor. The listless and reluctant attention which is met with in some schools is the opposite to that which holds good in those which are properly managed. Instruction must be adapted to the child's power; the talk must be made pleasant to the pulpil if it is to be rapidly understood. It is a great mistake to suppose that many hours per day must be devoted to study. Little children may be taught best by playing with them and by instructing them in their play and by their play. They learn much more efficiently than by compelling their attention in the solemn way which is followed in some dame schools, and even in schools for older children. To sit on a form and be quiet is necessary sometimes to enable the teacher to bring his class into proper subjection, but to make it the custom of the school is wrong. Sedentary occupation is altogether out of the question for little children; half an hour at one time is ample for them to be compelled to devote their attention to any one subject. There should be a relaxation for a short time every now and then for absolute play: a time for the muscles to follow their natural tendencies. For very young children even fifteen minutes is a sufficient length of time for close attention to one subject. Two to three hours a day at irregular intervals of corresponding length is ample time for mental work for children under eight years of age. It is probable that fully developed brains cannot stand more than nine hours' continuous mental labour for any length of time, without paying for it sooner or later. The gradations from three hours to nine may be gradually brought about by an increase of about a third of an hour a day for each year. Let any one calculate the amount of attention which can be given to a sermon or lecture, without the supervention of 'ennui,' and which marks the weariness of the listener, and if the subject is not very interesting he will be able to calculate the damage which school life does to brain development when irksome work is made more irksome by being too long continued. The Kindergarten system is an admirable one for young children, provided it is not kept up by excitement. I fear that sometimes the teacher errs on this side, and by trying to excite the attention of the little child, he, or rather she, overestimates the power of the little brain by introducing exciting topics and figures in a way which provokes attention; this kind of teaching is wrong. Ingenuity and vivacity on the teacher's part are necessary, but excitement is to be deprecated. For children over four years of age, and under seven, an hour or two in a Kindergarten school with frequent and short intervals, during which the will of the child should be master, will be the best discipline. No set lessons should be permitted until the age of seven or eight years. I am of opinion that the teaching of our veteran hygienist, Edwin Chadwick, is right teaching, and that the so-called half-time system among older children will bring about a far healthier and complete population than that kind of education in which the whole time is given to study. It is found by experience that children who attend school only three hours a day frequently make as good progress as those who are in the school-house for six hours; the mental work, if continuous, is as much as is good for the child, whilst it gives evidence of real progress. I like the plan of emptying a school-room every half hour, and allowing ten minutes for healthy exercise out of doors, which should take the form of leaping, running, or some other active movement of a vigorous and spontaneous character; if this is not possible by reason of the state of the weather, then a kind of drill should be practised, either in the schoolroom, or, better still, in some covered way, or in some other room, so that opportunity may be given for a purification of the vacated room by a thorough ventilation. I like the plan also which is adopted in some schools of regular drill at irregular intervals whilst at work at the desk. On a given signal from the teacher, say a particular kind of bell sounding, all the boys start to their feet at 'attention,' and perform a few muscular movements in rapid and regular succession. This change promotes a perfect circulation in the blood; it takes away from the muscular system a tendency to improper contraction, that which gives rise to annoying habits which many people get of beating time, in a way, which is sometimes called 'the devil's tattoo,' or having other 'peculiarities,' indicating a deformity of nerve force. The custom of drill is also advantageous as teaching children to be in subjection in a proper manner, and without injury to any part of the system. It also prevents them from becoming so absorbed in their work, by which they forget other duties altogether and become what is called absent-minded, to their serious detriment in after life.

SCHOOL DESKS AND SEATS.

Bad position in writing, drawing, and standing in class, or sitting upon a simple form, are very prominent causes of deformity. Twisted spinal columns, malformations in chest, stooping habits and shuffling gaits, with many kinds of bodily ailments, follow a want of knowledge by the teacher upon these points. Not the least evil is the influence which indulgence in a wrong position has upon the eyesight. The bad construction of the seats and desks which are in ordinary use in all schools has been a fruitful source of evil. Even the indulgence in right-handed work leads to malformation of muscles. It is therefore much to be desired that children should

be encouraged to practise exercises of all kinds with the left hand as well as the right, and even to learn to write with the left hand in early life, certainly to draw lines and figures with both hands equally well; and to handle the bat, and throw the ball first with one hand and then the other. It will be conducive to excellence in the end by producing a perfectly-fashioned figure, and preventing the formation of irregularly-developed muscles. This applies to the small muscles as well as those of larger size, and in no case with so much effect as with the minute muscles which regulate the eyesight. The eyeball is swung in a kind of sling which is acted upon by six muscles. The custom in school life frequently appears to be to prevent the development of these muscles by saving them from exercise altogether. Children are allowed to bring the eye in close proximity to the paper or the book, to twist the spine so that one shoulder is brought down and the other elevated; the neck is so twisted that the axis of vision is perverted, and one eye being on a different level to the other, the set of muscles in use are not equally acted upon, so that one muscle gets to be stronger than the other. The axis of vision is irregular, and the child gets more and more SHORT-SIGHTED. The next error is that which so-called 'oculists' encourage: the child is made to wear spectacles, by which means the chance of cure is taken away. The eye is irretrievably damaged by this course. The proper means to be taken is to exercise the eyes by making the child use the muscles together, and in an equally continuous manner, by placing him at a small distance from a series of letters attached to a wall, and then causing him to step backwards a few inches at a time, and encouraging him to use the muscles by focussing the eyes so as to get those muscles to act in harmony, and to lengthen the distance at which vision is perfect. If all the short-sighted children in a school were treated in this way for twenty minutes at a time every day, it would be found that the spirit of emulation would bring the muscles to equal and regular action, and the use of spectacles rendered unnecessary; that is, if the improper positions commonly indulged in at the desk are prevented by the class teacher. Desks must not be of an equal height for all children, they must be capable of regulation, so that a boy five feet high need not be obliged to sit at the same level as one four feet two. The taller boy has to stoop, or the shorter boy has to raise his head too much. The desk must not be too near or too far from the seat, and a flat desk is a mistake. The desk should incline slightly towards the child. The feet should be supported by a foot-board, and there should be always a fairly curved back to the seat so as to prevent fatigue to the child, and its natural consequence, a curve of the spinal column in the direction not provided for by nature. The seat upon which the child sits should not be a flat surface, but somewhat saddle-shape. It is discomfort which leads to deformity. Every effort should be made to obviate this by meeting the difficulty, either by providing support, or by taking the child away from the desk at frequent intervals to exercising another set of muscles by another kind of action. Change of posture and variety of movement are the best remedies for those misshapen conditions which are fostered in badly-conducted schools. The effect of drill is easily seen in the soldier. There is no deformity to be seen in the ranks; that which is effected in the army could be much more easily achieved in the school playground if a little attention was daily given to this subject. I am not advocating luxurious habits in reading and writing; fatigue should follow upon all work, but when the fatigue comes it is best to change the character of the occupation, and not allow it to go on in the same groove for too long a period. If this change of occupation is carried out properly, the position of the child is not of so much moment, but it is best for him to sit erect when writing to keep the eyes in a parallel line with the surface of the desk. the shoulders at an equal height, and the elbows close to the side, and not resting upon the desk itself. Weakly and delicate children should have a support for the whole of the back. I shall refer to these points more at length in the next volume, when treating upon the surgical requirements of school-life, as these are matters completely connected with curative means as well as preventive measures.

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Practical Lessons on Insect Life.

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No. X.—THE TRICHOPTERA AND HYMENOPTERA.

THE *Trichoptera—i.e.*, 'hairy winged' insects, were until comparatively of late years supposed to form part of the *Neuroptera*, to which they certainly bear a close resemblance.

The wings are four in number, generally tolerably equal in size, and, as a rule, more or less profusely covered with hair; the second pair are folded beneath the upper when the insect is at rest. The mouth, in the perfect insect, is not developed, so that no nourishment can be taken, just as is the case with the common May-fly.

The *Trichoptera* include those insects which are popularly known as Caddis-flies, and which are so dear to anglers, both in the larval and perfect stages of their existence.

In their life-history, as well as in the general details of their structure, the caddis-flies bear a strong resemblance to the dragon-flies, passing the earlier portion of their life beneath the surface of the water. Unlike those insects, however, they construct for themselves habitations, or 'cases' in which to pass their larval existence, these differing in structure according to the

species of the insect, and the nature of its surroundings.

As a rule, these cases are more or less cylindrical, and are formed of all manner of substances, leaves, sand, small stones, sticks, etc., being amongst those usually employed. The grub is, however, by no means particular in its choice, and will make use of any suitable object which may fall in its way.

Two small hooks may be noticed at the extremity of the body, by the agency of which the larva is enabled to retain its position in the case.

Towards the middle of May these cases may be found in great abundance in any suitable pool, a single sweep with a net often bringing up several double handfuls. A few weeks later on the perfect insects appear, and may be found in plenty in the neighbourhood of water. Several British species are known, but lack of space prevents me from describing them, and forces me to proceed at once to the next order of insects, namely, the *Hymenoptera*, or 'membranous winged' insects.

This can by no means be considered as a happy title, answering equally well to almost any of the great groups of insects. There is, however, no difficulty in distinguishing a hymenopterous insect at first sight, the anterior and posterior wings being united when in use by a series of small hooks running along part of the upper edge of the lower wing, and fitting into a groove in the lower edge of the upper wing.

These hooks differ in form to a very considerable degree in the various families of the *Hymenoptera*, those from the wing of a wasp, for instance, being very distinct from those taken from a bee or ichneumon. So much is this the case, indeed, that an experienced entomologist can detect, by the examination of a single hook, to which family of the order its owner belonged.

The second pair of wings are always much smaller than the first, and are intersected by fewer veins. The head is furnished with a pair of horny jaws, and also with a fleshy tongue, lying between and protected by them. The abdomen of the female is provided with an ovipositor formed of several parts, modified in some groups into a poison-bearing sting. The pupa is invariably quiescent, as is also the larva, except in the case of the Saw-flies.

The *Hymenoptera* are usually divided into two chief sections, viz., the *Terebrantia*, or 'Borers,' and the *Aculeata*, or 'Sting-bearers.'

The first subdivision of the leading group includes the Saw-flies and Gall-flies, in which the base of the abdomen is attached to the thorax by the whole of its diameter, the larvæ feeding upon vegetable substances of various kinds, and being furnished with horny mandibles and a well-developed mouth.

The saw-flies bear the appropriate title of *Tenthredinidæ*, an appellation formed from a Greek word signifying to gnaw, or nibble. The wings of these insects are large, the nervures forming several distinct cells; the abdomen is not connected with the thorax by means of a footstalk, and is provided, in the female, with the curious apparatus from which the name 'Saw-fly' is derived.

This consists of a couple of flat horny plates, placed side by side on the under surface of the extremity of the abdomen. These two plates constitute the saws, one edge being set with elaborately formed teeth, while the other is strengthened by a thick horny plate. In fact, the structure of the instrument almost exactly resembles that of our own tenon saws.

These saws slide into grooves, and are so constructed that one is withdrawn while the other is thrust forward. By their agency, a resting-place is prepared for the eggs, a groove being cut in a leaf, or twig, an egg placed therein by the ovipositor, and fastened by a small drop of a glutinous fluid secreted by the insect.

The larvæ of the saw-flies differ from those of the groups of *Hymenoptera* in possessing limbs, and passing an active existence. At first sight they might easily be mistaken for the caterpillars of lepidopterous insects, the general structure being of very much the same nature. Their true character, however, may be easily ascertained by an examination of the claspers, or false legs, which are never more than ten in number in the larvæ of the *Lepidoptera*, while the grubs of saw-flies possess from twelve to sixteen of these members.

Perhaps the most abundant, and certainly the most destructive of our British saw-flies, the Turnip-fly or Nigger (*Athalia spinarum*), must not be passed by without a few words of notice.

This terrible pest to the agriculturist is, happily, rather capricious in its visits, being seldom common in the same district during two successive years. When it does make its appearance, however, the turnip-crop vanishes as though before a swarm of locusts, scarcely a plant being spared by the voracious grubs.

Another destructive saw-fly is that known as *Nematus grossulariæ*, the larva of which wreaks considerable havoc upon the foliage of gooseberry bushes.

The last of our British saw-flies which can be mentioned in these pages is one that by few except practical entomologists would be taken for a saw-fly at all, the form and colouring being so like those of a hornet, that the mistake is little to be wondered at.

This insect is scientifically known as *Sirex gigas*, and is usually tolerably plentiful in pine woods, upon the solid wood of which the larva feeds.

In this insect the saws are modified into a sharp and powerful boring implement, consisting of three portions, the two outer parts acting as sheaths to the inner, or actual piercing tool. This weapon attains to a considerable size, being, in an ordinary female *sirex*, little short of an inch in length.

We now come to a very remarkable group of *Hymenoptera*, namely, the *Cynipidæ*, or Gall-flies.

These insects, usually of very small dimensions, produce the excrescences upon various trees and plants which are generally known as Galls, and which form a habitation for the larva. These galls are caused as follows.

The female insect makes a small puncture in a leaf or twig, and deposits therein an egg, and a small drop of an irritant fluid. This acts in some strange manner upon the juices of the plant, causing a swelling to form, in the middle of which lies the egg. This in due time hatches, and the young grub finds itself provided both with food and dwelling.

It is a curious fact that the eggs, both of the saw-flies aud gall-flies, increase in size to a considerable extent before the larvæ are hatched.

A vast number of gall-flies are already known to science, and others are annually being discovered. There are, however, but few students of the group, the small size and obscure habits of the insects rendering the study of their habits a matter of the greatest difficulty.

As a general rule, one larva only inhabits each gall.

With some species, however, the gall is composed of a number of cells, each containing a separate grub.

One of the most familiar of all the galls is that popularly known as the 'Oak-apple,' and which is produced by the dull-coloured little *Cynips Kollari*. Scarcely an oak tree or bush but bears a quantity of these curious objects, which are often used by way of ornament in the construction of various fancy articles.

Some of the gall-flies are double-brooded, and present a very remarkable phenomenon, the two generations being to all appearance totally distinct from one another, and having until very lately been considered as representing separate species. Recent investigators, however, have found that, different as they appear, they are in reality only alternate broods of the same insect.

The *Ichneumonidæ* comprise a vast number of insects, whose life-history is of the most singularly interesting nature.

These creatures are parasitic upon other insects, the larvæ usually spending their existence within the body of their victim.

Therein an egg is deposited by the parent insect, the young larva almost immediately hatching, and commencing to prey upon the body of its involuntary host. Instinctively avoiding the vital organs, it continues to feed upon the fatty portions until it attains its full development, when its victim succumbs to its attacks, almost the whole of the interior having been eaten away.

In some cases, a single egg only is deposited in the body of the larva; in others, the parasites may be reckoned by the hundred. In one instance, over one thousand specimens of a small ichneumon-fly were bred from a single larva of the Wood Leopard Moth (*Zeuzera æsculi*).

So vast is the number of insects composing this group that we cannot do more than glance at the history of more than two or three species, the first of which shall be the little insect known as *Microgaster glomeratus*.

This ichneumon must be ranked in the category of our insect benefactors, preying, as it does, upon the larvæ of the well-known 'white' butterflies, which are so terribly destructive to the cabbage crops. In some districts, indeed, the larger and more destructive of these insects has been almost annihilated by its tiny foe, and scarcely a single specimen is now to be seen where the butterfly formerly existed in thousands.

When full-fed, the parasites leave the body of their victim, and construct small cocoons of yellow silk, in which to pass their pupal existence. These cocoons may be seen in great numbers upon the fences bordering any field of cabbage, and are usually considered by ignorant persons as the 'caterpillar's eggs,' and destroyed accordingly.

The only other ichneumons to which space, or rather, the want of it, permits us to allude, are the curious little *Pezomachi*, which are parasitic upon the eggs of various spiders. These insects are without wings, and so closely resemble ants that a close examination is required to identify them.

The next great group is known as the *Aculeata*, or Sting-bearers, and comprises several families, the first of which consists of the ants. These, although represented in this country by comparatively few species, abound in tropical lands to an almost incredible degree.

These insects may be divided into two groups, namely, the social and the solitary ants. Very few of the latter are found in this country, and the interest centres almost entirely upon the social species.

These ants, like the bees and wasps, apparently consist of three sexes, namely, the male, the female, and the worker. It has of late years been discovered, however, that two sexes only in reality exist, the workers being nothing more than undeveloped females. One great proof of this fact lies in the possession by the workers of stings, which, in all the *Aculeata*, are found in the female insects alone.

In these ants, the perfect male and female only are furnished with wings, the workers being unprovided with those organs. Even the perfect insects bear them for a short time only, making a single flight into the air, where they choose their mates, and snapping them off close to the body immediately upon descending to the earth.

It has been well remarked that, if the anthropoid apes approach most closely to man in bodily form, the ants, small and insignificant though they are, most nearly resemble him in point of intellect. And when we come to examine the wonderful details of their life-history, of the organisation and regularity found in every part of the nest, of the division of labour, each individual insect having its appointed work apportioned to it, and of the manifold ways in which these insects seem almost to imitate man himself, we cannot but wonder that creatures so small, possessed neither of speech nor, to all appearance, of reasoning powers, should yet be enabled to perform feats requiring such surprising intelligence.

Many human institutions are found reproduced amongst these wonderful insects. Standing armies are kept up, and divided into corps, battalions, regiments, and companies, all under the command of regular officers, just as is the case with our own troops. The warriors go through the most surprising evolutions with an order and regularity worthy of the most highly-drilled soldiers in existence. Slaves are captured from other nests, and perform the duties of domestic servants and nurses. Several species of ants even bury their dead, and in numberless other ways prove the advanced state of their intellectual powers.

Volumes might easily be filled with descriptions merely of the habits of these wonderful little creatures, and we cannot but regret that lack of space obliges us to proceed to the next division of the *Hymenoptera*, namely, the *Diploptera*, or insects whose lower wings are folded longitudinally when not in use. This group comprises the insects popularly known as Wasps.

As is the case with the ants, there are solitary and social species, the former consisting of perfect male and female insects only, while in the latter undeveloped females, or workers are found, and play a very important part in the economy of the hives. These workers, however, are possessed of wings.

Very few of the Solitary wasps inhabit Great Britain, chief among them, perhaps, being the curious *Odynerus melanocephalus*, which hollows out the dead twigs of rose trees, etc., and constructs therein a series of cells, in each of which it deposits an egg, and a small caterpillar or two by way of food to the future grub.

The British Social wasps, eight in number, all belong to the genus *Vespa*, and construct nests of great beauty from a paper-like substance, formed by masticating small fragments of wood. With some wasps these nests are built underground, or in a hollow tree, or

other suitable locality; others construct pensile habitations, usually from the branch of some tree or bush. To the first class belongs the common wasp, while the little known tree-wasp and Norwegian wasp are included in the latter group.

In the British Museum may be seen a very curious series of nests of the common wasp, built by insects in the possession of the late Mr. S. Stone.

The Bees are included in the *Anthophila*, or 'Flower-lovers,' a family sometimes known as the *Mellifera*, or 'Honey-bearers.' These insects may also be divided into two groups, the social and solitary, the workers being only found in the insects of the former division.

The life-history of the most familiar species, viz., the common Hive Bee, is too well-known to need any description in these pages, and we will therefore conclude this paper with a short account of one or two of our less understood bees.

The most familiar of the wild social bees are those which are commonly called Humble Bees. Some make their nests in holes in the ground, some upon the ground, and others in rocky crevices.

The first-mentioned is the most plentiful. It takes possession of the deserted burrow of a rat or field-mouse, enlarges it as required, and by degrees produces a numerous brood. The cells are not hexagonal, and formed into combs like those of the hive bee, but are oval, and heaped together without any attempt at arrangement. This is the case with all the humble bees.

The Carder Bee (*Bombus muscorum*) is remarkable for the curious manner in which the nest is constructed, the insect collecting moss, grass, etc., and carefully drawing them through her legs, in much the same manner as wool is carded. With the material thus prepared, she builds a kind of dome-like structure upon the ground, carefully covering it so as to resemble the surrounding earth. Within this are constructed a series of oval cells, placed at irregular intervals.

This is a very common species, and, if approached with care, may be examined while at work, and the structure of the nest inspected.

The Red-hipped, or Stone Humble-bee (*Bombus lapidarius*), is a very familiar species, and derives the second of its popular titles from the situation of its nest, which is generally placed beneath a heap of stones. Should such a position be unattainable, the nest is usually constructed in a hole in a bank, or other convenient locality.

In all, about eighteen or twenty species of humble-bees are found in Great Britain, many of this number however, being extremely scarce.

(To be continued.)

Anecdotal Natural History.

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No. XII.—THE RHINOCEROS, HYRAX, AND HIPPOPOTAMUS.

THE RHINOCEROS is connected with the elephant by a number of links, such as the Tapir, in which a small and imperfect proboscis is present, and the various swine, in which the proboscis is modified into a very mobile, blunt-tipped snout, with the nostrils at the extremity. Geology, too, has revealed traces of many animals which are now extinct upon the earth, and which render the transition between these animals very much less abrupt, conclusively proving their approximate position in the scale of creation.

The rhinoceros, of which several species are known, is found in various parts of the African and Asiatic continents, preferring those neighbourhoods in which water is easily to be obtained. Although the various species differ in several minor characteristics, they are sufficiently alike in their chief peculiarities of structure to allow of a single description sufficing for the whole.

The so-called 'horn' is naturally the first point to attract our attention; and a very curious and wonderful object it is.

Notwithstanding the powerful shocks it is called upon to bear, and its uses as a weapon of offence, it is not in any way connected with the skull, as is almost universally imagined to be the case. It is, in fact, merely a growth from the skin, from which it may be removed by a few cuts around the base from a keen-bladed knife. An ordinary pen-knife is quite sufficient for this purpose. This horn must be ranked in the same category with hair, spines, and quills, the structure being precisely similar in all. This may be at once proved by an examination of the horn, which, although smooth and polished at the tip, is separated at the base into a number of filaments, the hair-like formation of which may be easily seen.

In order to avoid the effect upon the brain of the violent concussion caused by the headlong charges of the animal, the bones of the face are modified in a very remarkable manner, forming a kind of broad and strong arch, one end of which is left free and unsupported. Above this end the horn is situated, the elasticity of the bony arch effectually breaking the force of the shocks. The horn does not attain its full dimensions for several years after the birth of the animal.

In olden times, the horn of the rhinoceros was held in great estimation on account of its supposed poison-detecting powers, and bore a fancy value in consequence. Eastern monarchs, for example, were accustomed to have their drinking-cups formed from the horn, the superstition being that any poison introduced into the vessel would cause the contents to bubble violently, and so bring about a discovery of the attempted assassination.

At the present time the horn is still of considerable value, being largely employed in the manufacture of umbrella handles and various other articles.

The skin of the rhinoceros is of great thickness, and of so tough a nature that it will resist any but a specially hardened bullet. The balls used in the chase of the animal are therefore alloyed with solder or tin or mercury, in order to supply the requisite hardness.

By the natives of both Africa and Asia the skin of the rhinoceros is greatly prized, being largely utilised in the manufacture of shields, which form a most effectual protection from spears, no matter how keen their points or how great the force with which they are hurled. Even a rifle bullet, indeed, unless fired at close quarters, would probably be checked or turned aside in its flight.

Yet, stout as is the skin in most parts of the body,

there are places where its character seems to be altogether changed. In the Asiatic species of rhinoceros, for instance, the skin falls in heavy folds upon the neck, shoulders, and flanks, forming flaps which may be lifted up with the hand. Beneath these folds the skin is of a much softer and more delicate nature, and may be pierced without any very great difficulty. This fact is taken advantage of by the various parasites which infest the tropical forests, and which insinuate themselves beneath these folds, directing their attacks upon the thinner skin lying beneath them, and driving the animals almost mad by their incessant persecutions. Upon the under side of the body, also, the skin is comparatively soft.

Here we find a reason for the fondness of the rhinoceros and its allies for wallowing in the mud, the thick tenacious substance rapidly hardening beneath the rays of the sun, and affording an impenetrable barrier to the tiny assailants.

The eyes of the rhinoceros are by no means large, and are placed rather deeply in the head, the sight consequently being of a rather imperfect nature; in fact, the animal is unable to see any object directly in its front. The senses of scent and hearing are, however, developed to a considerable extent, and fully compensate the animal for its partial lack of visual power.

The INDIAN RHINOCEROS (*Rhinoceros unicornis*) is chiefly remarkable for the comparatively small size of the horn, the height of which sometimes little exceeds the diameter. It nevertheless forms a most effectual weapon, a well-known traveller stating that this animal is able to hold its own against an adult male elephant.

Another of the Asiatic species is the Sumatran Rhinoceros, which is provided with two horns upon the head instead of one. It does not appear, however, to make use of its formidable weapons, for its disposition is very quiet and timid, the animal flying from the presence of danger, and seldom facing even a single dog.

FOUR distinct species of rhinoceros are at present known to inhabit Africa, and it is yet uncertain whether still others do not exist.

The best known of these is the Rhinaster, Borele, or Little Black Rhinoceros of Southern Africa (*Rhinoceros bicornis*), which may be known by the shape of the horns and the upper lip.

The anterior horn is long, pointed, and curved backwards towards the head, while the posterior one is small and conical, closely resembling the weapon of the Indian rhinoceros. The upper lip, which is sharply pointed, overlaps the lower to a considerable extent.

The Borele is usually considered to be by far the most savage of all the species of rhinoceros, and the natives are said to fear the animal far more than they do the most infuriated lion. When wounded it is a truly dangerous opponent, and will attack its foe with a ferocity and determination which render escape a matter of considerable difficulty.

During the day-time the animal is seldom to be seen, selecting some secluded retreat in the thickest part of the forest, and there passing the hours of daylight. When night sets in, however, he awakes, and at once sets out for the nearest pool in order to slake his thirst before prosecuting his search for food.

This he generally finds in various roots, which he ploughs out of the ground by means of the powerful horns, and also in the young shoots of the 'wait-a-bit' thorn. Clumsy as it is in appearance, this rhinoceros is yet active and agile to a wonderful degree, possessing considerable speed, and severely trying the powers even of a good horse when attempting to escape from its furious onslaught.

Another well-known African species is the Keitloa or Sloan's Rhinoceros (*Rhinoceros keitloa*), which may be readily distinguished from the borele by its horns, which are of considerable and almost equal length. It is altogether a larger animal than the preceding, and is, if anything, even more to be dreaded as a foe, owing to its superior strength and length of horn.

Both the borele and the keitloa are black in colour; there are, however, two African species of rhinoceros in which the colour of the skin is a greyish white.

The first and more abundant of these is the common White Rhinoceros, or Muchuco, as it is termed by the natives (*Rhinoceros simus*), which differs considerably in appearance from the two above-described species. Setting upon one side the colour of the skin, the chief differences may be summed up as follows. The muzzle is square instead of pointed, the head is elongated, and the anterior horn attains to considerable dimensions, three feet being by no means an uncommon length. The second horn, however, is of far lesser size, and closely resembles that of the borele.

In disposition, also, the animal is very different, being as mild and peaceable as the borele and the keitloa are fierce and savage. Even when attacked it seldom assumes the offensive, but generally seeks safety in flight instead of endeavouring to revenge itself upon its pursuer. Should its young be assailed, however, it will fight with great fury, and is then to the full as dangerous an opponent as either of its relatives.

The second of the white species, viz., the Kobaoba, or Long-horned White Rhinoceros (*Rhinoceros Oswellii*), is a very much rarer animal, and is far less generally distributed.

The anterior horn of the kobaoba is of considerable size, sometimes exceeding four feet in length. Owing to the manner in which the head is carried, this horn, which is almost straight, and is directed forward instead of backward, is generally found to be more or less worn away by the friction with the ground. In consequence of its length and straightness the horn is of great value in the market.

A walking-stick made of a single piece of this horn will fetch almost any price in London or Paris. In the old days of muzzle-loading rifles, a ramrod made of rhinoceros horn was invaluable, as it was almost unbreakable, and yet was tolerably light to carry. A large knob was left at one end, and so it became not only a loading rod, but a formidable weapon. Short clubs of similar form are much used by the Kaffir tribes in hunting, and are called knob-kerries.

All the African species of rhinoceros are occasionally to be seen in small herds of eight or ten specimens, but can yet be scarcely described as gregarious, each animal in time of danger separating from his companions and selecting his own path. They are not prolific animals, a single young one only being produced at a birth.

THE HYRAX.

We are told in Ps. civ. *v.* 18, that 'the rocks are a refuge for the conies,' and in Prov. xxx. *v.* 26,

reference is made to the same animal. 'The conies are but a feeble folk, yet make they their houses in the rocks.' The 'coney' is also named in the book of Leviticus as one of the animals which might not be eaten by the Jews.

Now, the coney which is here mentioned is not the rabbit, as most readers of the Scriptures suppose.

Rabbits are not frequenters of rocks. They live in holes which they excavate with their fore-feet, so that they need a tolerably loose soil, and would be entirely at a loss among hard rocks. The animal in question is a little creature, so like a rabbit in general appearance that it might well be mistaken for that animal.

Its teeth are apparently those of a rodent, and its feet look very much like those of the rabbit. It is clothed with brown fur, very much like that of the wild rabbit, and it is wonderfully active, darting about with such rapidity that the eye can scarcely follow its movements.

But, when examined by the eye of the zoologist, the rodent-like teeth are those of a miniature hippopotamus, and the paw-like feet are seen to be composed of hoof-clad toes like those of the rhinoceros. The rhinoceros has three toes on each foot, while the hippopotamus has four. The Hyrax has four toes on the fore-feet, and three on the hind feet. In fact, this little creature, so apparently dissimilar to the hippopotamus and rhinoceros, forms a connecting link between them.

The species of Hyrax which inhabits Africa is popularly called the Rock-rabbit by the English colonists, and Klip-das by the Dutch. Its scientific name is *Hyrax Capensis*, that of the animal mentioned in Scripture being *Hyrax Syriacus*. It is called 'Ashkoko' by the natives.

Both creatures have similar habits. They are exceedingly wary, darting into the recesses of the rock at the slightest alarm, or, if they fear that their movements may betray them, crouching motionless against the rock and resembling it so closely that the keenest eye can hardly detect them.

THE HIPPOPOTAMUS.

Having now traced the connection between the elephant and the swine through the tapir, and that between the rhinoceros and Hippopotamus through the hyrax, we come to the Hippopotamus itself.

This animal (*Hippopotamus amphibius*), often known as the River-Horse, or Sea-Cow, is a native of various parts of Africa, being never found very far from the neighbourhood of water. Huge as is the animal, its size lies chiefly in the bulk of the body, the legs being very short, and the actual height seldom exceeding five feet.

The teeth of the hippopotamus are of wonderful size and curious shape, the canines being strongly curved, while the incisors lie almost horizontally. These latter are chiefly used in tearing up the various aquatic plants upon which the animal feeds. These teeth are of very fine quality and close consistency, and, the ivory obtained from them retaining its colour for a great length of time, are of considerable value, averaging in price from £1 to £1 5s. per lb. A single tooth is usually from five to eight pounds in weight.

Formidable as these teeth appear, they are employed solely for the purpose of feeding, unless the animal is wounded, or otherwise irritated. For their legitimate purpose they are most suitable implements, capable of severing a stem of considerable size, or of cropping the herbage as closely as if a scythe had been employed.

In consequence of its huge appetite and destructive habits, the hippopotamus is an object of great detestation in the neighbourhood which it frequents, as its constant visits to the plantations in the vicinity result in an almost total destruction of the crops. And the havoc it causes is all the greater on account of the position of its legs, which, being very short, and set widely apart from one another, oblige the animal to make two distinct tracks, thus exactly doubling the damage caused by its passage through the crops.

In order to check its ravages as much as possible, various means are employed, chief among them being the pit-fall and the 'down-fall.'

The first of these needs no explanation, and the latter may be described in a few words.

A log of wood is heavily weighted at one end, and furnished with a spear-head dipped in poison. This is suspended to a branch over the path of the animal. To this is fastened a cord, which is carried across the track in such a manner that the pressure caused by the advancing hippopotamus causes the log to fall, and the poisoned spear to sink deeply into its body. The doom of the animal is then effectually sealed, the venom performing its destructive work in the course of a very short time.

The hippopotamus is also slain by means of a specially-constructed harpoon, consisting of a stout shaft, some ten or twelve feet in length, and a barbed point fitting loosely into a socket at the end of the shaft, to which it is fastened by means of a rope composed of a number of separate strands—this is in order to prevent the animal from biting it asunder. To the handle is fastened a stout line, to the other end of which a float is attached.

When an attack upon one of these creatures is contemplated, the hunters proceed, by means of a raft, into the midst of a herd, and plunge the harpoon into the body of the nearest animal. The wounded hippopotamus immediately dives, but is unable to shake off the harpoon, owing to the barbed point. As often as he rises he is attacked with spears, etc., which speedily complete the work of destruction.

Sometimes the wounded animal turns savagely upon its pursuers, and succeeds in tearing the raft or boat to fragments, occasionally killing one or more of the crew before they are able to reach the land.

The hippopotamus is generally found in tolerably large herds, each consisting of from twenty to thirty or more animals. Chiefly aquatic in their habits, they are generally to be found in the larger rivers and lakes. They are not averse to salt water, being often noticed floating or swimming in the sea itself.

The hide is enormously thick and strong, being fully two inches in thickness along the back. The well-known 'sjambok' whips are formed from this skin, which is prepared for use in a somewhat curious manner. Strips of suitable length are cut, and are then beaten with a hammer in order to consolidate the substance of the hide. This done, they are thoroughly dried, and are finally rounded off and polished by means of a sharp knife and sandpaper.

A well-made sjambok is a terrible weapon, capable of cutting a deep groove in a deal board with a single well-directed stroke.

There are two kinds of sjambok. One is used for driving oxen, and is attached to a long bamboo handle in such a manner that the complete instrument looks like a gigantic fishing-rod. In the hands of an experienced driver it becomes a terrible weapon, to which even the tough hide and obstinately sluggish nature of the African draught ox are forced to succumb.

The driver can direct his blow with unerring certainty, and a single stroke will cut completely into the skins of two oxen at once, raising a cloud of hair, and often causing blood to spirt from the wound. The crack of this sjambok is as loud as a pistol shot, and at the very sound of it the oxen fling themselves against the yokes so as to avert the dreaded blow.

The short sjambok is popularly known as the 'cow-hide,' because it is made of the hide of the 'sea-cow.'

In order to retain the vital heat below the surface of the water, a similar provision is found in the hippopotamus to that with which the whale is furnished. Beneath the skin is a thick layer of fat, a wonderful non-conductor of heat, while a system of glands keep the outer skin constantly lubricated with oil, and thus prevent it from coming into actual contact with the watery element.

The sub-cutaneous fat-layer is considered a great delicacy, and is known by the Dutch colonists as 'Zee-koe speck,' or sea-cow bacon.

The animal possesses the remarkable power of sinking the whole of its body beneath the surface at will, and remaining under water for a considerable period of time. It is probable that this feat is accomplished by some contraction of the body, so that, while the weight remains the same, the bulk is considerably decreased, and a lesser quantity of water displaced.

Like the rhinoceros, the hippopotamus, whether upon land or in the water, is usually a very sluggish animal, and seems greatly averse to active exertion. When attacked, however, or otherwise alarmed, it exhibits the most wonderful activity, dashing through the water in a series of tremendous leaps, or rushing through the forest with the most unexpected rapidity. Few obstacles can stand against the onset of an infuriated hippopotamus, the great bulk of the animal bearing down almost any barrier that can be opposed to it.

The colour of the hippopotamus is a dark brown, marked with a number of irregular lines resembling the cracks on the surfaces of old oil paintings. The skin is marked with a number of sooty black blotches, which are only visible, however, upon a close examination. When the animal is living, the ears, nostrils, and the ridge over the protruding eyes are of a bright red colour, and form capital marks for the rifle of the hunter.

The slaughter of the hippopotamus by means of the rifle is not at all an easy process, as the animal, when alarmed, sinks at once to the bottom, and only occasionally rises to the surface for air. Even on these few occasions the nostrils alone are exposed above the surface, so that only a very well-directed bullet can do any harm.

The hunter always endeavours to lodge his first ball in the nostrils, as, if they be wounded, the animal is unable to remain submerged. A second bullet in the eye, or behind the shoulder, will then mostly complete the business.

When in her native rivers, the female hippopotamus is a model parent to her offspring, carrying her cub about on her back, and tending it with the most affectionate care and solicitude. In confinement, however, she generally behaves differently, and has on more than one occasion been known to kill her infant in a fit of passion.

In former days the hippopotamus was a native of Europe, and the fossil remains are found even in our own country, the London clay being especially productive in these relics of a bygone time.

(To be continued.)

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'How I Teach Elementary Science.'

BY RICHARD BALCHIN,

Head Master of the Gloucester Road Board School, London.

FOURTH-SCHEDULE SUBJECTS: 'MECHANICS.'

IN the lesson on 'Matter in motion' I endeavoured to lead the boys to the conclusion that every object we see around us is 'on the move'; that every particle of matter is in motion; in fact, that 'motion is the law of the universe.' At the close of my remarks, a boy asked the question—'What makes everything move?' Another boy seemed especially anxious to know why the little specks he could see in the sunshine were all in motion. Although in the next lesson—viz., the one on 'Force'—I had intended to proceed to the consideration of the various forces in nature from a different startpoint from that suggested by the boys' questions, I at once decided that it would be preferable to take those questions and let them form the basis upon which to build up in the children's minds all the conceptions I wish them to have concerning 'force.' It is not an easy matter to get boys to grasp clearly the true nature of force. Of course it *is* a very easy matter to make the boys learn verbal definitions of the various forces; and some teachers may be content to do thus much; but no true educator will. In the present article I do not intend to re-produce a lesson, but rather to indicate how I treat this portion of the subject. In the first place, it is necessary that I should myself have clear and correct conceptions of the nature of force, and then that I should decide upon the best way of evolving such conceptions from the ideas already in the minds of the boys. Let me therefore state first what I understand the scientists of the day to mean when they talk of 'force.' We become cognizant that the matter of the universe, of which we form a part, manifests under certain circumstances distinct properties, qualities, or 'affections.' Of these affections of matter, we may enumerate—attraction, heat, light, motion, electricity, magnetism, etc. Some of these, and probably all of them, may be resolved into one, viz., 'motion.' That is to say, magnetism, for instance, is a motion of the atoms of the body said to be magnetised. So is electricity. The two motions different. One, for example, may be motion in an angular manner; the other straight. Again, light and heat are modes of motion of the atoms of matter. In infinitesimally short distances. Inconceivably rapid. In other words, that these affections are not in themselves 'entities.' Not things having an existence of themselves. When, for instance, I put a poker in the fire and it gets hot, it is

not that something called 'heat' has passed from the fire and gone into the poker, but that the atoms of iron, etc., which make up the matter of the poker have been put into motion. It is this motion we become conscious of and call 'heat.' When any of these affections re-act upon matter, the re-action is termed 'force.' For example, when the sun's heat re-acts upon the carbon dioxide (carbonic acid) that has entered the leaf of a plant by the stomata, and also upon the mass of green cellular matter, in the midst of which the gas is introduced, the heat force is sufficient to break up the CO_2, to fix the carbon in the leaf, and liberate the oxygen. We therefore speak of 'heat force,' magnetic force,' 'force of gravitation,' and so on. Probably what we term 'muscular force,' is but a modification of heat force. Any one force having operated, is not thereby annihilated; it re-appears either as the same, or as some other force. I have said that these affections of matter may be resolved into one—motion—and so force is said to produce motion. Practically this is sufficient. It is, however, quite clear that force is but a 'subtle mental conception.' We do not see force, we only know or see its effect—motion. The next question is, how much of all this shall I place before youthful minds. This will, of course, depend upon the capacity of those minds. I feel that it would be quite impossible for any fifth and sixth standard boys to grasp all that I have here stated. What shall I do then? Shall I tell them that force is something else, easier to explain? Certainly not. I will say what is true, or say nothing. A short time since, one of my assistants was giving a lesson on the expansion of metals by heat. This was his explanation. 'There is something' said he, 'called heat or caloric, that enters into the body of the metal.' He then went on to explain that this something gets between the atoms of the metal, takes up room, and pushes those atoms farther apart. Therefore the mass of metal must occupy a larger space. If more heat be introduced, the atoms go farther apart and the solid becomes a liquid; if still more heat be applied, the atoms are pushed apart altogether, and the liquid becomes a vapour. Now this statement was clear enough to the boys—that is, they easily understood what the teacher meant. A conception *had* certainly been formed in their minds. But was it true? Calling the teacher on one side, I asked him if he had read Tyndall on heat. He said he had. 'Then,' I remarked, 'that is not the way *he* treats of heat.' The teacher admitted it was not, but that he felt it impossible to get the boys to grasp Tyndall's notion of heat, and so had adopted an easier method of explanation. 'But,' said I, 'you have told the boys something that when they grow up and read, they will have to *unlearn*, because false. Now this morning in the Scripture lesson you said it was good to honour parents; is it not possible that when they discover your statement about heat to be false, they will entertain a doubt respecting the "honour due to parents"?' And so with regard to 'force;' I cannot expect the boys to grasp the entire subject; I must therefore submit a few elementary ideas, which shall, however, be correct as far as they go; so that in after life the boys, if so minded, may safely build up upon the foundation I have given them, but not find themselves compelled to sweep away that foundation entirely, and lay one more solid and genuine.

The following is my 'method' in giving a lesson on 'force.' Call one or two boys out, and get them to move various objects about—*i.e.*, push the inkstand along on the table, carry a chair from one part of the room to another, and so on. Lead them to see the necessity of having a word to denote the exertion they have each put forth. So get the word 'force.' Write on the board 'force produces motion.' Note the raindrops or flakes of snow in motion, explain the force that produces or gives rise to this motion—viz., the force of gravitation, or the force of the wind which is the result of heat force, and of gravitation. So by many examples lead up to the conception that all motion necessarily implies the operation of some force. Note some of the forces in nature. Then gradually conduct the class to the definition:—Force is that which produces or tends to produce motion, or that changes or modifies motion. If time will allow, definitions may be given of the 'force of gravitation,' 'chemical force,' 'electric and magnetic force,' and, if a lesson has already been given on 'heat,' then a definition of 'heat force.' It is pleasing to see how soon the boys get to connect the idea of force with that of motion. Force causes the mountain stream to flow, brings down the water of the cataract, acts upon the weights of the clock and sets wheels and hands moving, and drives all machinery.

In next month's article I will reproduce the lesson upon the relations of 'force,' 'energy,' 'work,' etc.

Education Department.

Syllabus for Male Candidates.

DECEMBER, 1882.

The Examination for Certificates will commence on Monday, the 11th of December, 1882, at 3 p.m.

1. This Syllabus shows the extent of the examination, but Acting Teachers may obtain Certificates who can *read and *write well, and answer simple questions confined to the following subjects:—

(1) English History (leading facts).
(2) Geography (elements of, and British).
(3) *Arithmetic (including proportion, practice, vulgar and decimal fractions).
(4) *English Composition, Spelling, and Parsing.
(5) *School Management, including in all cases questions under Section 2 of the second year's paper on this subject.
(6) Geometry, in the case of Candidates for a certificate qualifying them to be entrusted with the charge of Pupil Teachers.

2. Failure in any of the subjects marked with an asterisk excludes a Candidate from a certificate.

3. Acting Teachers attending the examination may, at their option, take the papers of the first or second year. The questions set will be such as can be answered from text books in common use.

4. The relative proficiency of the candidates according to examination, and whether they were examined in papers of the first or second year, is recorded in their certificates.

Reading and Repetition from Memory.

First Year.

To read with a distinct utterance, due attention to the punctuation, and just expression. Each *Student* must have learned at least 300 consecutive lines of poetry from the work selected under Grammar (section 2), and will be called upon to repeat some part at the Annual Inspection of the Training College.

Second Year.

Candidates will be expected to show improvement in the higher qualities of reading, such as expression, modulation of

* The Students of the *first* year will be expected to read a passage from Goldsmith's *Traveller and Deserted Village*, Milton's *Comus*, and Lamb's *Tales from Shakespeare*; the Students of the *second* year from Shakespeare's *Richard II.* and *Tempest*, and from a newspaper. These authors must not be studied in class, but must be left to the private reading of the Students.

voice, and the correct delivery of long or involved sentences. Each *Student* must have learned at least 300 consecutive lines of poetry, or 200 consecutive lines of prose from one of the works named under Grammar, and will be called upon to repeat some part at the Annual Inspection of the Training College.

Penmanship.

First Year.

1. To write a specimen of the penmanship used in setting copies of text hand and small hand,
2. To write a passage from Dictation.
3. The general character of the writing in the Examination Papers will be considered in deciding upon the proficiency of Candidates in the subject.

Second Year.

As in First Year, but defects more severely visited with loss of marks.

NOTE.—Writing, as taught in schools, is apt to be too small and indistinct. Pupils should be taught to write a firm, round, legible hand.

School Management.*

First Year.

1. The methods and principles of elementary teaching, generally, and with special reference to the development of the intelligence of children.
2. Notes of Lessons.
3. The form of school registers, [the mode of keeping them, and of making returns from them.

Second Year.†

1. To teach a class in the presence of Her Majesty's Inspector.‡
2. To answer questions on the following subjects :—
(*a*) The different methods of organising an elementary school.
(*b*) The form of school registers, the mode of keeping them, and of making returns from them.
(*c*) The ventilation and drainage of school premises.
3. The training of the senses and of the memory ; the processes of reasoning ; the order in which the faculties of children are developed ; the formation of habits and of character ;—all considered in their application to the methods of teaching and of moral discipline.

Grammar and Composition.

First Year

1. The elements of Grammar.
2. To parse words selected from passages in Byron's *Childe Harold's Pilgrimage*, Canto IV., Stanzas 1–48, and 140–end.
3. To analyse passages from the book selected.
4. To write plain prose upon a given subject.
5. An explanation of the meaning and words in the selected passages.

Second Year.

1. To paraphrase passages from Shakspeare's *Macbeth*, and Bacon's *Essays* (1–26).
2. To answer questions on the language, style, and subject-matter of the work chosen for paraphrase.
3. To write plain prose upon a given subject.

Geography.

First Year.

1. The elements of Geography, Mathematical and Physical.
2. To describe in words, and draw the map of, the four quarters of the globe, of each country in Europe (that of Great Britain in fuller detail), and of Hindostan, Australia, New Zealand, Canada, and the South African colonies.
3. The Political Geography of the British Empire.

Second Year.

1. The Geography—Physical, Political, and Commercial—of the British Empire.
2. Map drawing, confined within these limits.

History.

(The papers will contain questions on the history of Scotland.)

First Year.

General outlines of British History.

Second Year.

A special period in greater detail. From the year 1715 to the accession of Queen Victoria.

Arithmetic, Algebra, and Mensuration.

First Year.

1. To work Arithmetical sums, both mentally and on paper.
2. To prove and explain the rules.
The figures should be well formed and the work methodically arranged as a good model for children to imitate.
3. To answer simple* questions, both theoretical and practical, in Algebra, and the Mensuration of plane surfaces.

Second Year.

More difficult questions,* and problems, in Algebra and Mensuration.

Geometry.

First Year.

The first two books of Euclid, with simple deductions from the propositions.

Second Year.

The first four books of Euclid, and the first *fifteen* propositions of the Sixth Book, with simple deductions from the propositions.

Economy.

Second Year.

Elementary Questions in Political Economy. Works on this subject, published of late years for use in schools, contain matter to which these questions will have reference.

Vocal Music.

First Year.

1. Notation: the treble and bass staves, and the relation between them.
2. Time : Simple common, and simple triple.
3. The scales, major and minor ; with the intervals (major and minor, perfect or other) found in both, and the chromatic intervals found in the latter.
4. Transposition from one key to another ; and transcription from one variety of time to another (as from $\frac{2}{2}$ to $\frac{2}{4}$).

Second Year.

1. Notation : The alto and tenor staves, and their relations to the treble and bass.
2. Time : Compound common, and compound triple.
3. Classification of intervals, as perfect and imperfect, consonant and dissonant.
4. Resolution of individual dissonant intervals.
5. Rudiments of harmony : Positions of chords ; progression ; inversion ; discords by suspension (on fundamental basses only); the discord of the dominant seventh (in its direct form only).

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* Passages taken from Reading Lesson Books commonly used in schools may be given in the papers on all subjects which admit of it, and candidates will be expected to show how they would explain such passages to children. Each paper may also contain questions on *the method of teaching* the elementary parts of the subject to which it relates.

† No student will be examined, unless the Principal certifies that he has spent at least six weeks, or 150 hours, in the Practising and Model Schools, under proper superintendence, during his residence, and at least half that time during his second year.

‡ Students to be examined under Article 105 must also teach a class in the presence of Her Majesty's Inspector.

* In *Algebra*, the Students of the first year should understand the four simple rules, involution, evolution, common measures, common multiples, algebraic fractions and surds, ratios and proportions, progressions, and the solution of simple and easy quadratic equations, of one or more unknown quantities, or problems producing such. Those of the second year should, at least, add to this a knowledge of permutations and combinations, the Binomial Theorem, logarithms, interest and annuities, scales of notation, and the solution of more difficult equations or problems producing such.

In *Mensuration*, the Students of the first year should understand the measurement of every species of plane rectilineal figure. Those of the second year should add to this a knowledge of the measurement of circles or parts of a circle, cylinders, spheres, cones, and a few irregular solids.

Students of the first year who do not obtain at least 60 per cent. of the total number of marks obtainable in Algebra and Mensuration will be required to take up the same portions of those subjects in their second year.

NOTE.—A *paper* on this subject is not given to any Student, about to leave the Training College, who has not passed the Musical Inspector's examination in practical skill. Acting teachers who take this paper must produce a certificate from some competent person (such as the organist of their church) that they have '*such an* '*amount of musical skill, vocal or instrumental, as* '*is sufficient for the purpose of teaching children to sing* '*from notes.*'

Drawing.

[*N.B.*—This exercise does *not* form part of the *December* examination. Annual examinations, *in drawing only*, are held at each of the *Training Colleges* under inspection some time in November, and at the various *local drawing schools* in connection with the Department of Science and Art, at times to be learned from the masters of those schools. The value of the exercises is marked, and the marks carried to each candidate's total, for a certificate under this Syllabus.]

The series of exercises prescribed in the Art Directory* of the Department of Science and Art for a drawing Certificate of the Second Grade.

Special Subjects.

Additional marks will be given to a Candidate for success in some of the following subjects, provided that he passes for a Certificate, according to this Syllabus, without counting marks for these special subjects.

I. Languages.

1. Latin.
2. Greek.
3. French.
4. German.

Candidates may take one or two (but not more) of these languages. *Students* will be examined in those languages only for which a special course of instruction is provided in the Time Table of their College.

First Year.

This paper will contain grammatical questions, and easy passages† in prose for translation from and into English.

Second Year.

This paper will contain harder passages† (in poetry as well as prose) for translation from and into English prose, with questions upon the construction of particular sentences.

II. Science.

See Extracts from Minute of 17th January, 1878.
At Whitehall, the 17th day of January, 1878.

BY THE RIGHT HONOURABLE THE LORDS OF THE COMMITTEE OF HER MAJESTY'S MOST HONOURABLE PRIVY COUNCIL ON EDUCATION.

1. The Lords of the Committee of Council on Education consider the subject of Science Instruction in Training Colleges. They believe that the time has arrived when a special examination should be instituted at a period of the year better adapted to the Training Colleges than May; and that the nature of the examination and the payments made on the results should be modified to suit the circumstances of those Colleges.

2. They therefore determine that in future a special examination in Science shall be held in Training Colleges in December, immediately before the ordinary Christmas Examination.

3. *The examination will not be open to Acting Teachers.* It will be held in those subjects only for which a special course of instruction is provided in the time table of the College, and will be conducted by one of Her Majesty's Inspectors, or by an officer of the Science and Art Department.

4. No Student in a Training College will be allowed to attend the May examinations of the Science and Art Department.

5. The examination will be confined to the following ten subjects:—

1. Mathematics.
2. Theoretical Mechanics.
3. Applied Mechanics.
4. Acoustics, Light and Heat.
5. Magnetism and Electricity.
6. Inorganic Chemistry, including practical Chemistry.
7. Animal Physiology.
8. Elementary Botany.
9. Physiography.
10. Principles of Agriculture.

6. No Student will be permitted to take up more than *two* subjects in any one year. Women will not be permitted to take more than one subject in a year.

7. The examination, except for Mathematics, will be based on the syllabus of the several subjects given in the Science Directory. But the two stages, Elementary and Advanced, will be treated as a whole—one paper only being set. These examination papers will be framed much as the present May papers are framed, that is to say, with a certain number of compulsory questions, and a certain number of optional questions, some of the latter being more difficult, and more highly marked, than the rest. Questions will also be set on the method of teaching various branches of the subject. The syllabus for the Mathematical examination is given in the Appendix.

8. The successful Students will be placed in the 1st or 2nd Class, the Standard for a 2nd Class being as high as that of a *good* 2nd Class in the present Advanced Stage, and for the 1st Class of a *good* 1st Class in the Advanced Stage.

9. All Students who pass will be registered as qualified to earn payments on results and will receive certificates, but no prizes will be given.

APPENDIX.

SYLLABUS FOR MATHEMATICS IN TRAINING COLLEGES.

Geometry—

All the propositions of plane geometry; including the doctrine of proportion, so far as it is treated in the definitions of the fifth and in the sixth book of Euclid.

Algebra—

Up to indeterminate coefficients and continued fractions.

Logarithms—

Trigonometry—

So far as it is required for the measurement of triangles, areas, heights, and distances.

Solid Geometry—

First principles, including the volume and surface of the right cylinder, cone, and sphere.

A student who passes in this subject will be registered as qualified to earn payments on results in Stages 1, 2, 3, and 4 of Mathematics.

N.B.—1. A Student may not, in either year, take up more than *four* special subjects.

2. A Student who, at the end of his first year, passes with credit in History, or Geography, or both, may in his second year omit such subject, or subjects.

3. A Student who fails to pass with credit in either, or both, of these two subjects, must take it, or them, up again in his second year, and may not, in that year, take up more than *three*, or *two*, special subjects.

4. Acting Teachers, who attend the Christmas Examination, will receive additional marks for any two of the specified Science Subjects, in which they may have obtained a first or second class in the Advanced Stage or in honours, at one of the May Examinations held by the Science and Art Department.

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* For information respecting the examinations in Science and Art, and for copies of the Science and Art Directories, application may be made to "The Secretary, Science and Art Department, South Kensington, London W."

† In 1882 the passages will be taken from *Cæsar de Bello Gallico*, Book II., Virgil's *Æneid*, Book VI., Xenophon's *Anabasis*, Book II., Euripides, *Medea*, Saintine's *Picciola*, Book I., Molière's *L'Avare* or Racine's *Athalie*, Goethe's *Italian Journey*, and Schiller's *Maria Stuart*. In 1883 the passages will be taken from *Cæsar de Bello Gallico*, Book III., Virgil's *Æneid*, Book VI., Xenophon's *Anabasis*, Book III., Euripides' *Medea*, Bonnechose's *Lazare Hoche*, Molière's *L'Avare*, Goethe's *Italian Journey*, and Schiller's *Maria Stuart*.

Education Department.

Syllabus for Female Candidates.

DECEMBER, 1882.

The Examination for Certificates will commence on Monday, the 11th of December, 1882, at 3 p.m.

1. This Syllabus shows the extent of the Examination, but Acting Teachers may obtain Certificates who can *read and *write well, receive, in the case of females, a good report for *needlework, and answer simple questions confined to the following subjects:—

a. English History (leading facts).
b. Geography (elements of, and British).
c. *Arithmetic (including proportion, practice, vulgar and decimal fractions).
d. *English Composition, Spelling, and Parsing.
e. *School Management.

2. Failure in any of the subjects marked with an asterisk excludes a Candidate from a Certificate.

3. Acting Teachers attending the examination may, at their option, take the papers of the first or second year. The questions set will be such as can be answered from Text Books in common use.

4. The relative proficiency of the candidates according to examination, and also whether they were examined on the papers of the first or second year, is recorded in their certificates.

Reading and Repetition from Memory.

First Year.

To read with a distinct utterance, due attention to the punctuation, and just expression. Each *Student* must have learned at least 300 lines of poetry from the work named under Grammar (section 2), and will be called upon to repeat some part at the Annual Inspection of the Training College.

Second Year.

Candidates will be expected to show improvement in the higher qualities of Reading, such as expression, modulation of voice, and the correct delivery of long or involved sentences. Each *Student* must have learned at least 300 lines of poetry from the work named under Grammar (section 1), and will be called upon to repeat some part at the Annual Inspection of the Training College.

Penmanship.

First Year.

1. To write a specimen of the penmanship used in setting copies of text hand and small hand.
2. To write a passage from Dictation.
3. The general character of the writing in the Examination papers will be considered in deciding upon the proficiency of candidates in this subject.

Second Year.

As in First Year, but defects will be more severely visited with loss of marks.

NOTE.—Writing, as taught in schools, is apt to be too small and indistinct. Pupils should be taught to write a firm, round, legible hand.

School Management.*

First Year.

1. The methods and principles of elementary teaching generally, and with special reference to the development of the intelligence of children.
2. Notes of lessons.
3. To answer questions on the form of, mode of keeping, and making returns from, school registers. (*This part* of the paper is to be omitted by *Students* of the first year, who are proceeding to a second year's residence.)

N.B.—Special questions will be inserted in the papers for candidates who, coming from, or being about to take, Infant Schools, desire to obtain special certificates as Teachers of Infants—

a. Method of Teaching Infants, and of conducting an Infant School.
b. Notes of Object Lessons.

*Second Year.**

1. To teach a class in the presence of Her Majesty's Inspector.†
2. To answer questions in writing on the following subjects:—
   a. The different methods of organising an elementary school.
   b. The form of school registers, the mode of keeping them, and of making Returns from them.
   c. The training of the senses and of the memory; the processes of reasoning; the order in which the faculties of children are developed; the formation of habits and character,—all considered in their application to the methods of teaching and moral discipline.

Grammar and Composition.

First Year.

1. The elements of Grammar.
2. To parse words selected from a passage in Byron's *Childe Harold's Pilgrimage, Canto IV., Stanzas* 1–48 *and* 140 *to end.*
3. To analyse a passage from the above.
4. An explanation of the meaning and words in the selected passage.
5. To write plain prose upon a given subject.

Second Year.

1. To paraphrase a passage from the play of *Macbeth.*
2. To answer questions on the language, style, subject-matter, history, and authorship of the play.
3. To write plain prose upon a given subject.

Geography.

First Year.

1. Elementary knowledge of Physical Geography.
2. To describe in words, and draw the map of, the four quarters of the globe, of each country in Europe (that of Great Britain in fuller detail), and of Hindostan, Australia, New Zealand, Canada, and the South African Colonies.

Second Year.

1. The Geography, Physical, Political, and Commercial, of the British Empire.
2. Map drawing confined within these limits.

History.

(The papers will contain questions on the history of Scotland.)

First Year.‡

General outlines of British History.

Second Year.

The History of England, military, constitutional, and literary, under the Tudors (1485-1602), *or* from the year 1715 to the accession of Queen Victoria.

Arithmetic.

N.B.—The figures must be well formed, and the sums worked methodically, and as good models for children to imitate. The papers for each year will contain questions requiring an explanation of the Arithmetical processes employed.

First Year.

1. The first four rules.
2. Practice and Bills of Parcels.
3. Vulgar Fractions.
4. Decimal Fractions.
5. Simple and Compound Proportion.
6. An exercise in Mental Arithmetic.

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* Passages taken from Reading Lesson Books commonly used in schools may be given in the papers on all subjects which admit of it, and candidates will be expected to show how they would explain such passages to children. *Each paper may also contain questions on the Method of Teaching the elementary part of the subject to which it relates.*

* No Student will be examined unless the Principal certifies that she has spent at least six weeks, or 150 hours, in the Practising and Model Schools, under proper superintendence, during residence, and at least half that time during the second year's residence.

† Students to be examined under Article 105 must also teach a class in the presence of Her Majesty's Inspector.

‡ *See* Appendix.

Second Year.

1. Simple and Compound Interest, Discount, Stocks, Insurance.

Domestic Economy.

First Year.

1. Clothing.
2. Food.
3. Laundry.

Second Year.

1. Cooking.
2. Household expenses and investment of money.
3. Practical rules for preservation of health.

N.B.—Only a percentage of the marks for this paper will be given in the case of those students (of both years) who do not present a certificate signed by the Superintendent, to the effect that she is satisfied with their practical proficiency in some specified portion of the work usually comprehended under the name of Industrial Training.

Sewing and Cutting Out.

First Year.

1. To cut out and make parts of any plain article of underclothing in common use.
2. To answer questions in needlework (within the above limits) on paper.

Second Year.

1. The work of a needlewoman in various branches applicable to the family of a working man.
2. To answer questions on paper.

Vocal Music.

First Year.

1. Notation: The treble and bass staves, and the relation between them.
2. Time: Simple common, and simple triple.
3. The scales major and minor; with the intervals (major and minor, perfect or other) found in both, and the chromatic intervals found in the latter.
4. Transposition from one key to another; and transcription from one variety of time to another (as from $\frac{4}{4}$ to $\frac{3}{4}$).

Second Year.

1. Notation: The alto and tenor staves, and their relation to the treble and bass.
2. Time: compound common, and compound triple.
3. Classification of intervals, as perfect and imperfect, consonant and dissonant.
4. Resolution of individual dissonant intervals.
5. Rudiments of harmony: Positions of chords; progression, inversion; discords by suspension (on fundamental basses only); the discord of the dominant seventh (in its direct form only).

NOTE.—A *paper* on this subject is not given to any Student, about to leave the Training College, who has not passed the Musical Inspector's examination in practical skill. Acting teachers who take this paper must produce a certificate from some competent person (such as the organist of their church) that they have '*such 'an amount of musical skill, vocal or instrumental, as 'is sufficient for the purpose of teaching children to sing 'from notes.*'

Drawing.

[*N.B.*—This exercise does *not* form part of the *December* examination. Annual examinations *in Drawing only* are held at each of the *Training Colleges* under inspection some time in November, and at the various *local drawing schools* in connection with the Department of Science and Art, at times to be learned from the masters of those schools. The value of the exercises is marked, and the marks carried to each candidate's total, for a certificate under this Syllabus.]

The series of exercises prescribed in the Art Directory* of the Department of Science and Art, for a drawing certificate of the second grade.

* For information respecting the examinations in Science and Art, and for copies of the Science and Art Directories application may be made to 'The Secretary, Science and Art Department, South Kensington London, W.'

Special Subjects.

Additional marks will be given to a Candidate for success in some of the following subjects, provided that sufficient marks be gained for obtaining a certificate, according to this syllabus, without counting marks for these special subjects.

I. Languages.

1. Latin.
2. French.
3. German.

Candidates may take *one* (but not more) of these languages. *Students* will be examined in those languages only for which a special course of instruction is provided in the Time Table of their College.

First Year.

This paper will contain grammatical questions, and easy passages* in prose for translation from and into English.

Second Year.

This paper will contain more difficult passages* (in poetry as well as prose), for translation from and into English prose, with questions upon the construction of particular sciences.

II. Science.

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BY THE RIGHT HONOURABLE THE LORDS OF THE COMMITTEE OF HER MAJESTY'S MOST HONOURABLE PRIVY COUNCIL ON EDUCATION.

1. The Lords of the Committee of Council on Education consider the subject of Science Instruction in Training Colleges. They believe that the time has arrived when a special examination should be instituted at a period of the year better adapted to the Training Colleges than May; and that the nature of the examination and the payments made on the results should be modified to suit the circumstances of those Colleges.

2. They therefore determine that in future a special Examination in Science shall be held in the Training Colleges in December, immediately before the ordinary Christmas Examination.

3. *The examination will not be open to Acting Teachers.* It will be held in those subjects only for which a special course of instruction is provided in the time table of the College, and will be conducted by one of Her Majesty's Inspectors, or by an officer of the Science and Art Department.

4. No Student in a Training College will be allowed to attend the May examinations of the Science and Art Department.

5. The examination will be confined to the following ten subjects:—

1. Mathematics.
2. Theoretical Mechanics.
3. Applied Mechanics.
4. Acoustics, Light and Heat.
5. Magnetism and Electricity.
6. Inorganic Chemistry, including Practical Chemistry.
7. Animal Physiology.
8. Elementary Botany.
9. Physiography.
10. Principles of Agriculture.

6. No Male Student will be permitted to take up more than *two* subjects in any one year. *Women will not be permitted to take more than one science subject in a year.*

7. The examination, except for Mathematics, will be based on the syllabus of the several subjects given in the Science Directory. But the two stages, Elementary and Advanced, will be treated as a whole—one paper only being set. These examination papers will be framed much as the present May papers are framed, that is to say, with a certain number of compulsory questions and a certain number of optional questions, some of the latter being more difficult, and more highly marked, than the rest. Questions will also be set on the method of teaching various branches of the subject. The syllabus for the Mathematical examination is given in the Appendix.

8. The successful Students will be placed in the 1st or 2nd Class, the Standard for a 2nd Class being as high as that of a *good* 2nd Class in the present Advanced Stage, and for the 1st Class of a *good* 1st Class in the Advanced Stage.

* In 1882 the passages will be taken from *Cæsar de Bello Gallico*, Book II., Virgil's *Æneid*, Book VI., Saintine's *Picciola*, Book I., Molière's *L'Avare* or Racine's *Athalie*, Goethe's *Italian Journey*, and Schiller's *Maria Stuart*. In 1883 the passages will be taken from *Cæsar de Bello Gallico*, Book III., Virgil's *Æneid*, Book VI., Bonnechose's *Lazare Hoche*, Molière's *L'Avare*, Goethe's *Italian Journey*, and Schiller's *Maria Stuart*.

9. All Students who pass will be registered as qualified to earn payments on results and will receive certificates, but no prizes will be given.

APPENDIX.

1. A Student of the first year may not take up more than one language *or* one science.
2. A Student who at the end of her first year passes with credit in history or geography *may* in her second year omit one of these subjects in which she has passed with credit, and take one language *and* one Science.
3. A Student who falls below a creditable pass in either or in both of these subjects *must* take it, or them, up again in her second year.

Acting Teachers.

Acting Teachers, who attend the Christmas Examination, will receive additional marks for any two of the specified Science Subjects, in which they may have obtained a first or second class in the Advanced Stage or in honours, at one of the May Examinations held by the Science and Art Department.

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Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I.

(1) Add together seven hundred and nine, eighty-four, six hundred, fifty-eight, five hundred and eighty, and four. Ans. 2035.

(2) From six hundred and eight, take one hundred and seventy-nine. Ans. 429.

(3) From seven hundred and fifty, take sixty-four. Ans. 686.

STANDARD II.

(1) From seventy-three thousand and eighty-four, take six thousand seven hundred and ninety-five. Ans. 66,289.

(2) Divide sixty-seven thousand eight hundred and thirty-six, by eight. Ans. 8479—4.

(3) Multiply sixty-nine thousand seven hundred and eight, by nine hundred and seven. Ans. 63,225,156.

STANDARD III.

(1) Write out in words the numbers,—3506, 400060, 10300, 1001. Ans. (none required for a *teacher*).

(2) A man owed bills to the amount of one thousand five hundred pounds and sixpence halfpenny. He paid first eighty-seven pounds six shillings and fivepence; then four hundred and seventy-three pounds nine shillings and eleven pence. How much did he still owe? Ans. £939 4s. 2½d.

(3) Add together: eight hundred and three pounds sixteen shillings and fourpence halfpenny, seventy-nine pounds eight shillings and tenpence, twelve shillings and ninepence three farthings, eight hundred and seventy-four pounds three shillings and fivepence farthing, six thousand and thirty-four pounds sixteen shillings and elevenpence halfpenny.

Ans. £7792 18s. 5d.

(4) Divide four hundred and eighty-two thousand three hundred and fifty, by six hundred and fifty-one. Ans. 740—610 remainder.

STANDARD IV.

(1) Multiply seventy pounds sixteen shillings and fourpence halfpenny, by eight hundred and six; and prove the sum. Ans. £57,079 18s. 3d.

(2) The distance between two towns is 188 miles. If a train ran at the rate of 82,720 yards in an hour, how long would it take to perform the journey?

Ans. 4 hours.

(3) Divide forty thousand and seventeen pounds sixteen shillings and fourpence halfpenny, by five hundred and seventy-three. Ans. £69 16s. 9¼d.—321 remainder.

(4) Reduce forty thousand three hundred and seventy-six pounds to tons, and prove the sum.

Ans. 18 tons. 0 cwt. 2 qrs.

STANDARD V.

(1) Find, by practice only, the value of eight hundred and forty-seven yards of cloth, at 1s. 7¼d. per yard. Ans. £67 18s. 8¾d.

(2) Make out and receipt the following bill:—

8 lbs. of tea at 2½d. per oz.
16 stone of salt at 4½d. per stone
9 stone of sugar at 1s. 9d. per ½ stone
3 dozen oranges at 1½d. each.

Ans. £3 8s. 8d.

(3) In what time will 48 men do a piece of work which 39 men can do in 16 days? Ans. 13 days.

(4) Find, by practice only, the cost of 6 tons 7 cwt. 1 qr. of coal, at £1 8s. 4d. per ton.

Ans. £9 0s. 3½d.

STANDARD VI.

(1) Add ¾, 6½, 1⅞, 6½. Ans. $16\frac{59}{80}$.

(2) Multiply 16·04 by ·32. Divide 1121·4 by ·534. Ans. 5·1328; 2100.

(3) Simplify $\frac{4\frac{1}{2} \text{ of } \frac{2}{5} \text{ of } 6}{\frac{1}{2} \text{ of } \frac{3}{4} \text{ of } 1}$. Ans. $28\frac{4}{5}$.

(4) Reduce 5s. to the decimal of 13s. 4d., and find the value of ⅗ of ⅔ of ½ of 15s. Ans. ·375; 3s.

(5) If 8 horses plough 26 acres in 4 days, how long will 12 horses be in ploughing 39 acres?

Ans. 4 days.

Physical Geography.

(1) What is the distance round the earth?

(2) What is the diameter?

(3) How long are the days and nights at the Poles?

(4) Why have we much more heat in summer than in winter?

(5) If it is 12 o'clock at London what time is it at New York, if there is 90° between them?

(6) When it is 12 o'clock at noon at London, what is the time at St. Petersburg, which is about 30° E. of London?

(7) What causes day and night?

(8) How long does it take the earth to rotate on its axis?

(9) When is the earth nearest the sun?

(10) Place lead-pencil in similar position to earth's axis.

(11) What shape is the earth's path round the sun? One word for it.

(12) When have we full moon?

(13) „ new „

(14) What is the relative position of the moon, earth,

and sun during full moon, new moon, eclipse of moon; also eclipse of sun?

(15) Why cannot we always see the moon?
(16) When do we see the moon in winter?
(17) Which of the planets is nearest the sun?
(18) When can it be seen? Why not always?
(19) Next planet? When can it be seen? What is it sometimes called?
(20) How many motions has the moon? What are they?

Grammar.

STANDARD IV.

Parse these sentences:—

(1) She took a long run.
(2) James did a just act.
(3) In return we spoke thus.

STANDARD V.

(1) Parse:—
(*a*) Having ill deserved this, I am angry.
(*b*) We lay resting among the meadow grass and flowers.
(2) Analyse:—
(*a*) To tell a lie is never right.
(*b*) He much desires to go away.

STANDARD VI.

(1) Parse:—
(*a*) If they be dead, I care not to live.
(*b*) Where can you be found?
(2) Analyse:—
It is not true that James is a better player than Henry.

Engagements for February.

February 1.	Parliamentary and Law Committee, N.U.E.T.	7.30 p.m.
,, 2.	Linnean Society	8 p.m.
	Royal Society	4.30 p.m.
,, 3.	Finance of Orphanage, N.U.E.T.	7.30 p.m.
	Council of Orphanage	8 p.m.
,, 4.	Organisation Committee, N.U.E.T.	10 a.m.
	Executive, N.U.E.T.	11 a.m.
,, 8.	Anthropological Society	8 p.m.
	Geological Society	8 p.m.
,, 9.	Royal Society	4.30 p.m.
,, 10.	New Shakspere Society	8 p.m.
	Finance of Prov. Soc., N.U.E.T.	7 p.m.
	General Board	8 p.m.
,, 13.	Finance and General Purposes Committee, N.U.E.T.	7.30 p.m.
	Royal Geographical Society	8.30 p.m.
,, 15.	Parliamentary and Law Committee, N.U.E.T.	7.30 p.m.
,, 16.	Linnean Society	8 p.m.
	Royal Society	4.30 p.m.
,, 17.	Geological Society—Anniversary Meeting	8 p.m.
	Executive, N.U.E.T.	7 p.m.
,, 18.	Organisation Committee, N.U.E.T.	10 a.m.
,, 20.	Central Committee of Benevolent Fund, N.U.E.T.	7.15 p.m.
,, 22.	Geological Society	8 p.m.
	Anthropological Society	8 p.m.
,, 23.	Royal Society	7.30 p.m.
,, 24.	Browning Society. Papers by J. T. Nettleship, Esq., and Miss Lewis	8 p.m.
,, 27.	Finance and General Purposes Committee, N.U.E.T.,	7.30 p.m.
	Royal Geographical Society	8.30 p.m.

Publications Received.

Arithmetic—

(1) Farnsworth's Domino Cards. J. B. Ledsham.

Drawing—

(1) Sweeting's Drawing Copy Books—Geometry. Walker & Co.

French—

(1) Grammar of the French Language. National Society.

Geometry—

(1) Wright's Lessons on Form. Longmans & Co.

General Literature—

(1) Maria Wuz and Lorenz Stark. Longmans & Co.
(2) Crawley's Handbook of Competitive Examinations. Longmans & Co.
(3) Bosco's History of Modern Italy. Longmans & Co.
(4) Bret Harte's George Washington Æsop's Fables. Hamilton.
(5) Mack's Scrap Packet. W. Mack.
(6) Dawson's Pamphlet on School Libraries. Bale & Sons.

Grammar—

(1) Nesbit's Grammarland. Third Edition. Houlston & Sons.

Greek—

(1) Arnold's Greek Prose Composition. Rivingtons.

Literature—

(1) Arnold's Poetry and Prose. Longmans & Co.
(2) Reade's How to Write English. J. H. Houghton.

Music—

(1) Choral Festival Music Book. Wesleyan Methodist S.S. Union.
(2) Wesleyan Methodist Tune Book. Wesleyan Methodist S.S. Union.

Periodical Literature—

(1) Our Little Ones. III. Griffith & Farran.
(2) Universal Instructor. XV. Ward, Lock & Co.
(3) The Oxford Examiner. I. E. Stanford.
(4) The Cambridge Examiner. E. Stanford.

Poetry—

(1) Palmer's Temptation of Job, and other Poems. Philip & Son.

Prize Books—

(1) Kilkee. Wesleyan Methodist S.S. Union.

Science—

(1) Watt's Scientific Industries Explained. Vol. II. W. & A. K. Johnston.

Sunday-School Literature—

(1) Senior and Junior Scholars' Tablets for '82. Wesleyan Methodist S.S. Union.
(2) Scripture Lesson List. Wesleyan Methodist S.S. Union.
(3) Anecdotal Illustrations of St. Mark. Wesleyan Methodist S.S. Union.
(4) Pleasant Talks about Jesus. Wesleyan Methodist S.S. Union.
(5) Wesleyan Methodist S.S. Magazine. 1881.
(6) Our Boys' and Girls' Volume. 1881.
(7) Our Boys' and Girls' Double Volume. '80 & '81.

Bell's 'Standard Elocutionist,' lately published by Messrs. Mullan & Son, has been purchased by Messrs. Hodder & Stoughton, who are now issuing the hundred-and-first thousand.

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A MONTHLY EDUCATIONAL JOURNAL.

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*** *We regret that, owing to the great pressure upon our space, the 'Monthly Notes' and 'Gossip' are again crowded out.*

'How I Teach Arithmetic.'

(*Continued from page* 557.)

BY WILLIAM SPENCER,

Author of 'Spencer's Exercises in Arithmetic.'

(*b*) After simple interest, naturally comes *Compound Interest*, which we at once proceed to consider. I first explain and illustrate the difference between simple and compound interest, that at simple interest the money due as interest is assumed to be paid when it is due—yearly or half-yearly generally. At compound interest, however, the interest is assumed as not paid, but is, when due, added to the principal, which consequently causes the interest to increase at an accelerated ratio. I should illustrate somewhat as follows:—I place out at interest two sums, each of £100, say in a bank, one of the sums being placed at simple interest, and the other at compound, the interest on each at 5 per cent. being due yearly. At the end of the year I receive the £5 due on the amount out at simple interest, but instead of receiving the £5 due on the other £100 I have it added to the £100, so that the banker has now £105 of mine, on which £105 the interest for the second year will have to be reckoned. For this second year the £105 will make £5 5s. interest, which now added to the £105 will make the principal £110 5s. for the third year. The interest on this last sum will be £5 10s. 3d., which added to the £110 5s. = £115 15s. 3d., the *amount* of £100 in the 3 years, or the principal for the 4th year if we wish to proceed any further. Hence the *compound* interest on the £100 for 3 years is £15 15s. 3d., while the *simple* interest on the other £100 is only (£5 × 3 =) £15; so that the compound interest is 15s. 3d. more than the simple interest.

(*b*1) We will now work an example or two requiring the *compound interest of a given sum for a given time*:—Find the compound interest of £7650 for 4 years at 2½ per cent. per annum. When the rate per cent. is a sub-multiple of 100, as $\frac{1}{10}$, $\frac{1}{20}$, $\frac{1}{40}$, etc., compound interest may be worked and represented most succinctly somewhat in the form of a practice sum as below, the work being performed decimally in £'s in preference to shillings and pence.

		£
2½ p. c. is	$\frac{1}{40}$	7650
		191·25 int. for 1st yr.
" "	$\frac{1}{40}$	7841·25 prin. for 2nd yr.
		196·03125 int. for 2nd yr.
" "	$\frac{1}{40}$	8037·28125 prin. for 3rd yr.
		200·93203125 int. for 3rd yr.
" "	$\frac{1}{40}$	8238·21328125 prin. for 4th yr.
		205·95533203125 in. for 4th yr.
		8444·16861328125 amt. in the 4 yrs.
		7650· the original prin. deducted
Answer		£794·16861328125 compd. int. for the 4 yrs.

20

s. 3·37226562500

12

d. 4·46718750000

Another example:—A young man who enters a situation at the age of 21, lays by out of his salary £20

at the *end* of each year, and invests his savings at 5 per cent. compound interest; what will he be worth at the age of 25?

£20 1st year's saving, or worth at 22 years of age.
1 interest on the above.
20 2nd year's saving.

41 worth at 23
2·05 interest on the above.
20· 3rd year's saving.

63·05 worth at 24.
3·1525 interest on the above.
20· 4th (last) year's saving.
£86·2025 = £86 4s. 0¾d. Ans.

Five per cent. being $\frac{1}{20}$, the interest is found by taking successively $\frac{1}{20}$ of the principal, or his worth at each year

In compound interest the interest is sometimes considered as due *half* yearly, when, of course, the interest for each *half* year must be added successively to the preceding principal. For instance, we see how many half years there are in the given time, and add so many times half-a-year's interest. If the rate be 5 per cent. add $\frac{1}{40}$ instead of $\frac{1}{20}$, if 4 per cent. add $\frac{1}{50}$ instead of $\frac{1}{25}$, or whatever the *modus operandi* for obtaining the interest, get half-a-year's only. Of course the oftener the interest is added to the principal the more rapidly the amount increases, as the following example will show. What is the difference of compound interest, between being payable yearly and half-yearly, of £575 at 4 per cent. for two years?

$\frac{1}{25}$ | 575£	$\frac{1}{20}$ | 575£
23.	11·5
$\frac{1}{25}$ | 598	$\frac{1}{20}$ | 586·5
23·92	11·73
£621·92	$\frac{1}{20}$ | 598·23
	11·9646
	$\frac{1}{20}$ | 610·1946
	12·203892
	£622·398492

£622·398492 amount half-yearly.
621·92 „ yearly.

£·478492 = 9s. 6·83808d. Ans.

Explain to the class clearly the result obtained—that nearly 9s. 7d. more would be made as interest by being reckoned as due half-yearly instead of yearly. I should point out also that if the interest was reckoned quarterly, the increase would be still greater; and as the operation would be very easy, though rather lengthy, by simply adding $\frac{1}{4}$ of $\frac{1}{25}$ or $\frac{1}{2}$ of $\frac{1}{50} = \frac{1}{100}$ to the principal eight times, I would have it worked out, and then compare the *three* results.

(*b*2) We will now *find the principal* that will amount to a certain sum, or produce a given interest in a given time. Here the principle and process are identical with those for simple interest given under *a*4. Without further comment we will therefore work out a short example. What principal will amount to £5000 in 2 years at 5 per cent. compound interest? Here we first find what £1, or £100—which I prefer, and therefore generally take—would amount to in the time. £100 + 5 = £105 amount in 1 year, and £105 + 5¼ = £110¼ amount in 2 years—5 per cent., that is $\frac{1}{20}$, being added in each case. As £100 amounts to 110¼, the principal is $\frac{100}{110\frac{1}{4}} = \frac{400}{441}$ of the amount; hence $\frac{400}{441}$ of £5000 = £4535 2s. $11\frac{55}{147}$d. Ans. As I have a firm belief of the utility of working out the same question by a variety of methods, I would find out what £1 amounts to, and then work it out decimally—thus, as £100 amounts to £110·25, £1 would amount to £1·1025, then as often as this last number will go in the £5000 will be the result in £'s. In dividing the £5000 by £1·1025, if the figures are continued as decimal of a £, they will not terminate, and consequently the *exact* answer as above would not be obtained, though if continued far enough would be sufficiently near for all practical purposes—to the infinitesimal decimal of a penny. By multiplying each number, however, by 10,000 we have £50,000,000 ÷ 11025, the decimals being eliminated, so that now it is simply compound division. In compound interest *the finding of the rate per cent.* as well as *the finding of the time*, corresponding to *a*2 and *a*3 respectively in our remarks on simple interest, are rarely attempted without the use of logarithms; here, therefore, we close our exposition of the teaching of interest.

(*c*) *Discount* naturally follows interest, and therefore to it we at once proceed. I first try to make clear the meaning of the term discount—something taken off an account for paying it before due. I suppose that I owe a person £105 due one year hence, and that money is worth 5 per cent. Well, he wants the money *now*, and I happen to have £100 to invest, so that I might either invest my £100 for a year making £5 interest and thus amounting to £105, or if he choose, instead of lending the £100 to a third party, I can pay him the £100 direct which will make *him* £5 interest. Hence at the end of the year, when the £105 is really due, he has got his full amount—£105. I have paid him £100 instead of £105, the £5 being discount, and the amount actually paid, called *the Present Worth, if put out at interest would make exactly the same money as has been taken off for discount.* These words in italics express the principle on which discount is based, and must be indelibly impressed on the memory, as well as clearly understood. Hence in order to find the discount of *any* sum of money, find what £100 would amount to at the given rate and for the given time—as in the above £100 amounts to £105,—then the present worth of £105 is £100, consequently the discount on £105 (mind, not on £100) is £5, that is $\frac{5}{105} = \frac{1}{21}$ of the given sum. Here explain clearly the meaning of Present Worth (generally expressed P.W.), and show the fitness of the term—*worth* at the *present* time.

(*c*1) We will now work out a few examples and make them the basis of any explanatory remarks:—*First, when the discount or P.W. is required.* What is the discount on £19 12s. 9d. due 2½ years hence at 4 per cent. simple interest? £4 × 2½ = £10 interest of £100 for the time, hence £100 would amount to £110; consequently the P.W. would be $\frac{100}{110}$, and the discount $\frac{10}{110} = \frac{1}{11}$ of the given sum; hence $\frac{1}{11}$ of £19 12s. 9d. = £1 15s. $8\frac{5}{11}$d. Ans.

What is the present worth of £50 due in 100 days at 3½ per cent? First, 100 days = $\frac{100}{365}$ = $\frac{20}{73}$ year, and £$\frac{7}{2}$ × $\frac{20}{73}$ = £$\frac{140}{146}$ = £$\frac{70}{73}$ interest of £100, hence £100 amounts to £100$\frac{70}{73}$; consequently the Present Worth equals $\frac{100}{100\frac{70}{73}} = \frac{7300}{7370} = \frac{730}{737}$ of the money given, and $\frac{730}{737}$ of £50 = £49 10s. 6$\frac{18}{37}$d. Ans.

Discount is generally reckoned on the theory or principle of *simple* interest, but for long periods it should be based on *compound* interest, otherwise the payee gains an advantage to the detriment of the payer. What is the discount of £750 due 2 years hence at 5 per cent. *compound* interest? Here £100 at compound interest would make £10 5s. in the two years, but at simple interest only £10; hence, as before shown the discount will be $\frac{10\frac{1}{4}}{110\frac{1}{4}} = \frac{41}{441}$ of £750 = £69 14s. 6$\frac{34}{49}$d. Ans. Had simple interest been reckoned the result would have been $\frac{10}{110} = \frac{1}{11}$ of £750 = £68 3s. 7$\frac{7}{11}$d.

(*c*2) We will now *find the original amount* when the present worth, time, and rate are given:—A person pays £725 ready cash for a bill due 8 months hence at 4 per cent.; what was the amount of the bill? Eight months = $\frac{2}{3}$ year, then £4 × $\frac{2}{3}$ = £2$\frac{2}{3}$ interest of £100; hence £100 would amount to £102$\frac{2}{3}$, that is, the P.W. is $\frac{100}{102\frac{2}{3}} = \frac{300}{308} = \frac{75}{77}$ of the full debt; or the full debt is $\frac{77}{75}$ of the P.W., and $\frac{77}{75}$ of £750 = £744 6s. 8d. Ans. Working on the basis italicised under *c*, the operation may be more easily performed; thus, £725 being the P.W., it would amount to the original sum in 8 months at 4 per cent. £725 × $\frac{4}{100}$ × $\frac{2}{3}$ = £19 6s. 8d. the interest, or in other words the discount that has been taken off; then £725 + £19 6s. 8d. = £744 6s. 8d. Ans.

(*c*3) We now proceed to *find the rate per cent.*, the other data being given. Here all that is required is an intelligent appreciation and application of the principle quoted under *c* and just applied above—*e.g.*, I owe a bill of £12 17s. 6d. due in 8 months, which I at once discharge by paying £12 10s.; what rate of discount am I allowed? It is evident from the data that 7s. 6d. is the interest of £12 10s. for 8 months, then 7s. 6d. × 1½ (a year being 1½ times 8 months) = 11s. 3d. the interest of £12 10s. for a year. Now £100 is just 8 times £12 10s., then 11s. 3d. × 8 = £4 10s. Ans.

Another example:—A bill of £841 3s. 4d. due in 9 months is cashed for £816 13s. 4d.; what rate per cent. per annum discount was allowed?

£	s.	d.				
841	3	4				
816	13	4				
3) 24	10	0	int. of £816 13s. 4d.	for	9	months.
8	3	4	"	"	3	"
32	13	4	"	"	12	"

Now £816 13s. 4d. = 8$\frac{1}{6}$ *hundreds* of £'s, and £32 13s. 4d. ÷ 8$\frac{1}{6}$ = (£196 ÷ 49 =) £4 rate per cent. Ans.

(*c*4) Lastly, we will *find the time* in which a sum of money would have been due—*e.g.*, a bill of £152 5s. is cashed for £150 at 4½ per cent. per annum discount; in what time would it have been due? Applying our principle as previously, £150 would amount to £152 4s. in some *unknown* time at 4½ per cent; that is, £150 would make £2 5s. interest in the unknown time at 4½ per cent. Now £150 would make £4½ × 1½ = £6¾ = £6 15s. in a *year*, hence whatever number of times, integral or fraction, that £2 5s. is (of) £6 5s. is the answer in years. As £2 5s. is ⅓ of £6 5s. the time is ⅓ year = 4 months. Ans.

From the explanations and workings under the above four heads, with an unlimited number of questions for class-work, I find that boys of average intelligence are soon able to work any ordinary question in discount however presented.

In closing our remarks on discount, we ought to mention that spurious kind called *Bankers' Discount*, which is simply discount reckoned as interest. For instance, I wish to cash a £100 bill, due 3 months hence at 4 per cent. The true discount would be $\frac{1}{101}$ of the £100 = 19s. 9$\frac{63}{101}$, but the bankers' discount would be simply the interest of £100 for the 3 months, that is £1, hence the advantage to the banker of nearly 2½d. This bankers' discount is also sometimes called traders' discount, where the slight advantage of course is with the pay*er*. Three days' grace can be legally claimed by the person or firm on whom a bill is drawn, so that it is not properly payable until three days after its *date* for payment.

(To be continued.)

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Publications Reviewed.

*** We are sorry to disappoint the many friends who desire us to quote the price of each work noticed in our columns. This we would respectfully point out is the publishers' duty and not ours; we give publicity enough to a book when we review it. Our readers should peruse the advertisements in our pages, and failing to find the price here, it would be no great trouble or expense to drop a line to the publishers whose name and address we will gladly give.

The Teacher's Handbook to the Circle of Knowledge. By the late Charles Baker. London: 67, Paternoster Row.

The well-known series entitled 'The Circle of Knowledge,' comprised an extensive compendium of all kinds of facts arranged in grades suitable to what we now term the different 'Standards.' The series proceeded under the assumption that the inculcation of information on every branch of knowledge was the main purport of education. But this cramming process—for such it really is—ignored to a great extent the cultivation of the reasoning powers, and left less room for taste, imagination, and fancy. By general consent the Gradgrind system was discouraged, and children were not condemned to read mere collections of facts. The book before us, however, is less open to the above objections, on account of its being designed for the use of teachers, and not as a reading-book for children. As a compendium of information it is doubtless valuable, and will save much trouble in hunting for materials for object-lessons, and the information contained in ordinary cyclopedias, together with a great deal of that which would have to be sought for in dictionaries. The statement conveyed in each 'lesson' is accompanied on the opposite page by a list of words, with their derivations and explanations. This occupies one column of the elucidatory page, the remaining column being made up of well-arranged questions on the subject-lesson. To some, these questions may be useful, but good teachers know that youthful intelligence

must be probed by question upon question, according to the answer given, and the mere set answer to a formal question be discouraged. It is, indeed, this probing process that develops true education. The final result may be gathered up, or may be often left unstated, like the *answer* of a sum, which, though apparently the most important part of an arithmetical operation, bears no comparison to the educational value of the *process* by which the result is attained. Leading questions thus employed have their use, and are free from the delusive notion of merely taking a question and its answer *without*—as a school-boy would say—*doing the sum*.

The so-called 'lessons' contain material enough in the way of facts and words for at least three or four ordinary lessons. To 'read, mark, and learn' should ever be accompanied with the remaining and most important part to 'inwardly digest.' It is by this means, and this alone, that intellectual strength is attained. A good teacher will not be annoyed at frequent forgetfulness of facts on part of little pupils, but be ready to say with Romeo—'And I'll still stay to have thee still forget.'

Scientific Industries Explained. By Alexander Watt. Edinburgh and London: W. and A. K. Johnston.

This, we ought to have indicated in the title, is the second vol. on Scientific Industries, the first of which we have already had to notice. The book before us begins with an explanation and description of the electric light. By the aid of several good illustrations the explanatory text brings this interesting subject within the comprehension of intelligent youthful readers. Among other applications of electrical action, this little volume treats of the deposition of alloys, electro-timing, and electro-typing in general. The telephone is also described. Perhaps the most interesting chapters are those on nickel-plating and the use of tungstate of soda and other anti-combustible appliances. This second volume is altogether a worthy sequel to its predecessor, and an interesting reading-book withal. Some valuable hints are given on the preservation of fish, meat, and other kinds of perishable food by means of salt, sugar, or by the application of a few well-known acids. To know that meat or fish immersed for a short time in water containing a small quantity of creosote will keep good for some time in very hot weather, is important to every housekeeper. To be aware also that by being immersed in a vegetable acid, such as wood vinegar, meat and fish will keep good for an indefinite period is of more value still to the thoughtful housewife. We have also some interesting accounts of the processes of preparing the tinned or canned meats, and other kinds of food, together with the now important process of refrigeration. After being landed in good condition on our shores after a long voyage, all that seems now wanting to ensure a continuous stock and supply of good fresh meat is the construction of refrigerating cellars or chambers at our ports or markets.

How to Write English. By A. Arthur Reade. Louth, T. H. Houghton; and London, Marshall and Co.

The study of English is greatly increasing, and its importance more and more appreciated. The command which some celebrated speakers and writers acquired over our language was often erroneously attributed to the influence of a classical education. But this is shown to be erroneous by the powerful clearness of writers unacquainted with Latin or Greek, as Bunyan, Cobbett, and Defoe. The labour, however, of translating and re-arranging words gives power to the classical student over his mother tongue, irrespective of the nature or peculiarities of the foreign language he studies. This truth of the need and value of labour, great and incessant, to attain facility—we talk not of perfection—in plain English is shown by Mr. Reade to be indispensable. In the examination papers of pupil-teachers failure in English composition is most common. Of course the necessity of labour is first to be seen, and next the wise direction of effort is no less important. Genius, according to some of our best thinkers, is the result of painstaking effort. Sydney Smith observed that 'A man proves a miracle of genius because he has been a miracle of labour.' In a similar manner Carissimi, when praised for the gracefulness and ease of his melodies, replied, 'Ah! questo facile quanto e' difficile!' which we may translate by, 'Ah! with what difficulty is this ease acquired!' Perhaps no writer shows more apparent spontaneity and freshness than Dickens, and yet a glimpse at Dickens' manuscripts show the exceeding care and frequent revision with which he wrote. Every branch of human effort tells the same tale, that the perfection of art is attained by great labour with the result of the apparent absence of all art. The study of the best authors Mr. Reade wisely shows has an imperceptible though real influence in regard to style. Among modern writers Macaulay stands deservedly high in regard to vigour, animation, copiousness, clearness, and pure English. His English was often homely, but never vulgar. Mr. Ruskin's style is so perfect that people are apt to value his sayings even more for their manner than their matter. We are especially glad to find Mr. Reade eschews the fine writing in which penny-a-liners are often tempted to indulge, and gives us some amusing examples from the *Daily Telegraph*, who told the public that the miners' grievances 'found a friendly echo in the philanthropic breast of Lord Shaftesbury.'

Dr. Johnson's unread writings and much-read talk are an excellent commentary on the unsuitableness of the former and the attractive force of the latter. This is amusingly exemplified in one of his letters to Mrs. Thrale in which he wrote:—'When we were taken upstairs, a dirty fellow bounced out of a bed in which one of us was to lie.' This was changed by the Doctor in his book for the following:—'Out of the bed on which we were to repose there started up at our entrance a man as black as a Cyclops from a forge.' This love of fine words is often a snare. An earnest preacher once evidently taken with the word *solitude* thus impressed it upon his hearers:—'The devil tempts us sometimes in our solitude, and sometimes when we are alone!'

We have transgressed our limits, or would also commend the good taste of Mr. Reade in recommending the avoidance of slang and vulgarity on the one hand as thoroughly as he discountenances fine writing, technicalities, foreign words, and in short any departure from what people most readily understand, and which refuses to court a smile by pandering to a low taste. The grammatical details are given in as readable and pleasant style as the general introductory recommendations. Altogether the book is much to be commended.

Board-School Gymnastics, for Home and School use. By Alfred T. Story. London: L. N. Fowler, Ludgate Circus.

Gymnastics has long formed a part of education, and is coming more and more into use. Boys have made cricket and their other athletic games increasingly popular since Hughes, Kingsley, and others associated physical exertion very closely with Christianity. With girls, gymnastic exercises have been mostly restricted to a few perfunctory performances with a back-board, a few rings, and a little irregular exercise with the dumb-bells. The little book before us gives a systematic course of exercises by which uniform and healthy development of the bodily powers can be attained. The author wisely observes that, 'What is required is not to make acrobats and athletes of children,' and that 'the simpler movements of the wand and dumb-bell exercises can be done by the youngest children.' The appliances recommended are so simple and inexpensive—comprising a few plain rods or wands, a few pairs of wooden dumb-bells, and a number of wooden rings—that the cost is simply next to

nothing. The exercises are not only clearly described, but what is of far greater importance, accompanied with clear illustrations, and advice as to the number of times each exercise should be repeated. Of course these exercises fail in the zest of enjoyment that good games impart, but games of an athletic kind for girls seem yet to be developed. The battledore and shuttlecock is a poor and mostly solitary affair, and the skipping-rope involves violent exertion that is liable to result in colds taken by subsequent rest. Another hindrance to good out-of-door games for girls is the want of room except under favourable circumstances. With these difficulties, a careful resort to such regular exercises as this book details is to be recommended as almost indispensable for health.

English Poetry and Prose, selected and edited by Thomas Arnold, M.A. London: Longmans, Green, and Co.

This collection on the lines of Chambers' 'English Literature' and innumerable others, contains specimens from most authors of repute, chronologically arranged, from the latter part of the seventh century, beginning with Caedmon (A.D. 680), down to the present date, marked by the recent death of Carlyle. No living author being quoted, the editor has thereby avoided invidious comparisons; but in a book of such comprehensive design we ought surely to find the names of Adam Smith, Bloomfield, Franklin, Alison, Burney, Elliott, Ellis, Palgrave, Nicol, and many others of unquestionable repute. Surely we ought to expect that the names of Bulwer and Disraeli would find a place beside that of Thackeray! Of course many omissions must be made in any book of selections, but these omissions ought to comprise the less known instead of the most popular and well-known authors. We fail also to fall in with some of Mr. Arnold's headings. The term Anglo-Saxon, we thought, was now being shunned by all thoughtful writers. The writers of the pre-Norman period may be classified under the term Old English, instead of this latter term being arbitrarily forced to do duty for Chaucer and his times. The term Renaissance is scarcely applicable, we think, to the literature of the early Tudors. In fact, these headings, unless chronological, ought to be free from unauthorised and fanciful terms. We are grateful for the translation appended to the extracts from Alfred and a few other writers of the early English period. This is followed by a copious footnote explanation of obsolete words from the latter part of the 13th to the middle of the 16th century, when the language approached its present form. The brief introductory notes are perhaps not to be complained of, as the book is professedly a sequel to, and designed to be used with, the author's 'Manual of English Literature.'

Handbook of Competitive Examinations. London: Longmans and Co.

We feel sure that many of our readers will thank us for drawing their attention to this really valuable handbook. Candidates for admission to any department of Her Majesty's service will find it indispensable. Dr. Crawley has done his work admirably. The book has the additional merit of having been corrected up to date 1882.

The River Singers. By William Robson. London: Wesleyan-Methodist Sunday-School Union.

We have nothing but commendation to express in regard to this book, which gives us an account of the influences of religion on the most ignorant of our neglected juveniles.

Senior Scholar's Tablet-Book for 1882. London: Wesleyan-Methodist Sunday-School Union.

These neat little books are brimful of good matter for every Sunday throughout the year. Headed by a well-drawn outline illustration—excellent for a small exercise in drawing—we have the Scripture lessons for the day, followed by an important passage called the Golden Text, a Hymn Verse, and two leading questions on Christian faith and duty. On the obverse, or page following, we have a page of Home Questions on these lessons, with blank lines for the written answers. The Tablets being in turn to be detached, renders a stiff cover perhaps needless. The books and the arrangements are highly to be commended.

Junior Scholar's Tablet-Book for 1882. London: Wesleyan-Methodist Sunday-School Union.

This book for junior scholars is on the same plan and marked by the same carefulness as that for seniors, but with of course easier questions and exercises.

Kilkee. By Eliza Kerr. London: Wesleyan-Methodist Sunday-School Union.

The locality of this juvenile story is on the north-west coast of Ireland, the wild grandeur of the scenery being descriptively interwoven with the incidents of the tale. Amid exciting and by no means unnatural adventures, the good conduct of a Sunday-school boy wins general attention and respect for his religious principles. His enemies are subdued by his forgiving spirit, combined with unflinching courage under dangers. One of his bitterest enemies died in peace on being assured of the forgiveness of Willie, the little hero of the tale. There is nothing of the sensational school, though plenty of incident, in this highly-commendable little tale.

Fables. By G. Washington Æsop and Bret Harte. London: E. Hamilton, Paternoster Square.

This little brochure may amuse 'children of an older growth' who will not be misled by the undisguised cynicism which pervades its pages. Some familiar fables are cleverly travestied and accompanied by humorous though roughly-drawn illustrations. The moral, often far-fetched, is not the less humorous on that very account.

Our Little Ones. January, 1882. London: Griffith and Farran.

This is a very good number of a periodical, of which we have, on more than one occasion, spoken well.

Mack's Scrap Packet. London: W. Mack.

In this packet there are two hundred different pictures, suitable for placing in a child's scrap-book. Some of the illustrations are of rare beauty.

The Anchor Pens. London: J. Walker and Co.

Messrs. Walker and Co. have sent us several boxes of their new anchor pens. We have used No. 3 (Broad Points) instead of the ordinary J pen, with thoroughly satisfactory results. The anchor pens are not only easy to write with, but hold an unusual quantity of ink.

Wesleyan-Methodist Sunday-School Magazine for 1881. London: 2, Ludgate Circus Buildings, E.C.

This charmingly-bound volume, brimful as it is of useful and entertaining matter, deserves a wide circulation. Many of the contributors are trained teachers of the ripest experience, Mr. Bailey, Headmaster of the Southlands College, and Mrs. Greenup being among the number. The papers supplied by the contributors just named are of special value, particularly to the young teacher. It would be hard to find a more suitable present for a Sunday-school teacher than this excellent volume.

SLIDING SONG.

Words by GEORGE BENNETT. *Music by* T. CRAMPTON.

Moderato. mf

1st TREBLE.
2nd TREBLE.
BASS.

1. Put a - side your books and slates, Bring out hock - ey - sticks and skates;
2. If it snows, ah! then what fun! Harm - less balls with - out a gun;
3. We shall meet at school a - gain, And will show our teach - ers then

KEY B♭. *Moderato. mf*

1st TREBLE. | s₁ :- :s₁ | s₁ :- :d | m :- :r | d :- · | f :- :m | r :- :d | t₁ :- :l₁ | s₁ :- :
2nd TREBLE. | m₁ :- :m₁ | m₁ :- :m₁ | s₁ :- :s₁ | s₁ :- : | r :- :d | t₁ :- :d | s₁ :- :fe₁ | s₁ :- :
BASS. | d₁ :- :d₁ | d₁ :- :d₁ | d₁ :- :r₁ | m₁ :- : | t₀ :- :d₁ | r₁ :- :m₁ | r₁ :- :r₁ | s₁ :- :

To the pond bring all play - mates— Keep the pot a - boil - ing! Yon - der see the
French or Eng - lish, which shall win?— Keep the pot a - boil - ing! Win - ter games our
How their mer - ry lit - tle men Keep the pot a - boil - ing! We will glad - ly

s₁ :- :s₁	m :- :d	t₁ :- :d	r :- :	m :- :d	l₁ :- :r	t₁ :- :-	s₁ :- :	r :- :d	t₁ :- :d
m₁ :- :m₁	s₁ :- :s₁	s₁ :- :fe₁	s₁ :- :	s₁ :- :m₁	fe₁ :- :fe₁	s₁ :- :-	s₁ :- :-	f₁ :- :m₁	r₁ :- :m₁
d₁ :- :d₁	d₁ :- :m₁	s₁ :- :l₁	t₁ :- :	d :- :d	r :- :r₁	s₁ :- :-	s₁ :- :-	s₁ :- :s₁	s₁ :- :s₁

skat - ers glide; O - thers dash a - long the slide; Off we go with stea - dy stride—
met - tle show, Warm - ing us from head to toe; And our hearts are all a - glow—
let them see What is meant by in - dus - try, For our mot - to then shall be,

r :- :d	t₁ :- :	m :- :r	d :- :r	m :- :r	d :- :	f :- :m	r :- :d	t₁ :- :l₁	s₁ :- :
f₁ :- :m₁	r₁ :- :	m₁ :- :m₁	l₁ :- :t₁	d :- :t₁	l₁ :- :	s₁ :- :s₁	l₁ :- :s₁	s₁ :- :fe₁	s₁ :- :
s₁ :- :s₁	s₁ :- :	se₁ :- :se₁	l₁ :- :l₁	m₁ :- :m₁	l₁ :- :	t₀ :- :d₁	f₁ :- :m₁	r₁ :- :r₁	s₁ :- :

f

Keep the pot a - boil - ing!
Keep the pot a - boil - ing!
"Keep the pot a - boil - ing!"

Symph. for Harmonium.

f

s :- :f	m :- :r	m :- :-	d :- :
s₁ :- :l₁	d :- :t₁	d :- :-	m₁ :- :
m₁ :- :f₁	s₁ :- :s₁	d₁ :- :-	d₁ :- :

Symph. for Harmonium.

f :-:*f*	*s* :-:*m*	*f* :-:*r*	*m*:-:-	*r* :-:*r*	*s* :-.*f*	*m* :-:-	*d* :-:
d :-:-	d :-:-	t₁ :-:-	d :-:-	s₁ :-:-	s₁ :-:-	s₁ :-:-	m₁ :-:
f :-:*r*	*m*:-:*d*	*r* :-:*t*₁	d :-:-	t₁ :-:-	t₁ :-:-	d :-:-	d :-:
d :-:-	d :-:*d*	s₁ :-:-	d₁ :-:-	s₁ :-:-	s₁ :-:-	d₁ :-:-	d₁ :-:

We beg to announce that any of the songs which have appeared in the back numbers of the PRACTICAL TEACHER may now be obtained separately, price 6d. per dozen, post free.

Query Column.

☞ As the answer to a single question often entails an expense six or seven times greater than the cost of the complete key to any of the Arithmetics or Algebras ordinarily used, the Proprietor of this Journal would be glad if students confined themselves to questions, the full working of which is not published in the form of a 'key.'

RULES.

1. Each correspondent is restricted to *one question.* We should be much obliged if correspondents who send numerical or algebraical questions for solution, and are able from any source to give the required answer, would do so. It would save much time at present spent on verification.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. Replies will not be sent through the post.

4. Correspondents are requested to write *legibly*, and on one side of the paper only.

5. Correspondents wishing us to recommend books for any (other than the ordinary Government) Examinations, or to answer any questions concerning that Examination, must, in all cases, send a copy of Regulations up to date.

6. Queries must reach the office *not later than the 15th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed

'The Query Editor,'
The Practical Teacher
Pilgrim Street, Ludgate Hill,
London, E.C.

Arithmetic.

1. YELSERP, Southampton.—A company is formed in which the liability of each partner is limited to the amount of his shares. There are 500 shares of £10 each; after 3 calls have been made of £2 on a share, it is found that the concern is a failure, and its affairs are wound up. At this period its assets amount to £10,217 0s. 0¾d. and its liabilities to £15,763 17s. 6d. How much will the company be able to pay in the pound after all the remaining calls are paid up?

Amount to be called up = (500 × 4) £
= £2000

£ s. d. £ £ s. d.
∴ 15763 17 6 : 1 :: 12217 0 0¾ : Dividend.
20 20
315277 244340
12 12
3783330 2932080
4 4
15133320 11728323
20
)234566460(15s. 6d. Ans.
1513332
8323326
7566660
756666

2. J. SKELETON, Jersey.—(*a*) A person invests £4620 in the 3 per cent. Consols at 92; what income does he receive, the brokerage being 2s. 6d. in the £? (*b*) Also what amount does he receive annually from his investment, after deducting an income-tax of 7d. in the £?

(*a*) Income on £1 = $\frac{3}{92\frac{1}{8}}$ £

∴ Income = $\frac{3 \times 4620}{92\frac{1}{8}}$ £

$= \frac{3 \times 4620 \times 8}{737}$ £

$= \frac{110880}{67}$ £

= £150 8s. 11$\frac{11}{67}$d.

(*b*) Net income on £1 = 19s. 5d.
∴ Net income = 19s. 5d. × $\frac{110880}{67}$

$= \left(\frac{233}{240} \times \frac{\overset{42}{110880}}{67}\right)$ £

$= \frac{21756}{67}$ £

= £146 1s. 2$\frac{34}{67}$d.

3. P. M'PHERSON, Glasgow.—We shall be pleased to give you all the assistance we can, but you ought not to send *unstamped* letters, leaving us to pay double postage.

A family of 14 persons has provisions for 30 days; after 21 days 4 more persons arrive: how long will the food last?

After 21 days the provisions would have lasted the original number, 9 days.

Total number of persons = 18.

∴ 18 pers. : 14 pers. :: 9 days : Time the remainder of the provisions will last;
= 7 days.

∴ The provisions will last 21 days + 7 days = 28 days.

4. MONTE CRISTO.—A gentleman bequeaths ⅓ of his estate to his son, and ⅓ of it to 3 friends (A, B, C) in shares, in the ratio of 3:2:1; he afterwards disposes of £500, and then divides the residue between B and C in shares, in the ratio of 4:1. If C's portion comes to £6,500, how much does each of the others receive?

C's portion = ⅓ of ⅓ of the estate + ⅓ of (⅓ of the estate − £500)
= $\frac{1}{9}$ of the estate + $\frac{1}{18}$ of the estate − £100
= $\frac{5+3}{90}$ of the estate − £100
= $\frac{4}{45}$ " " − £100

∴ $\frac{4}{45}$ of the estate − £100 = £6,500
$\frac{4}{45}$ of the estate = £6,600
∴ The estate = £6,600 × $\frac{45}{4}$
= £74,250.

Son receives ⅓ of the estate = £37,125.
A " ⅓ or ⅓ of ⅓ of the estate = ⅑ of the estate = £12,375.
B " £37,125 − (£12,375 + £6,500 + £500)
= £37,125 − £19,375
= £17,750.

5. X. Y. Z.—Two boys start at the same instant from the same corner of a square, the length of one of whose sides is 200 yards, and they ran round it in opposite directions. One (A) runs at the rate of 100 yards in 15 seconds, and loses two seconds in turning a corner; the other (B) runs at the rate of 100 yards in 16 seconds, and loses one second in turning a corner. Where do they meet?

A arrives at the first corner in 30 seconds,
and B " " " " 32 " :
A turns the first corner in 32 seconds,
and B " " " 33 " :

A arrives at the opposite corner in 62 seconds,
and A turns the opposite corner in 64 seconds:
Now in (64 − 33) or 31 seconds B has run $\frac{1}{8}$ of 200 yards;
∴ B is $\frac{1}{31}$ of 200 yards or $6\frac{1}{2}$ yards from the opposite corner.

Point where they meet $= \frac{16}{15+16}$ of $6\frac{1}{2}$ yds. from opposite corner

$= \left(\frac{16}{31} \text{ of } \frac{25}{4}\right)$ " " "

$= 3\frac{7}{124}$ yds. from opposite corner.

6. KAPPA, Weston-super-Mare.—Water runs into a cistern by one pipe and from it by two, in each pipe at a uniform rate when the pipe is open. The cistern holds 1,000 gallons. If all three pipes be open at once, the cistern supposed full, would empty itself in 200 minutes. If one escape pipe and the supply pipe only be open, it would, if empty, fill in 200 minutes. But if the other escape pipe and the supply pipe be open, in 100 minutes. How long would it take the two escape pipes to empty the cistern if the supply pipe were closed? (London Matric., June, 1881.)

Quantity emptied in one minute when all the pipes are open
$= \frac{1}{200}$ of 1,000 gallons
$= 5$ gals.

Quantity filled in one minute when the supply pipe and first escape pipe are open $= \frac{1}{200}$ of 1,000 gals. $= 5$ gals.

∴ Quantity emptied in one minute by second escape pipe
$= (5+5)$ gals.
$= 10$ gals.

Quantity filled in one minute when the supply pipe and second escape pipe are open $= \frac{1}{100}$ of 1,000 gals. $= 10$ gals.

∴ Quantity emptied in one minute by first escape pipe
$= (5+10)$ gals.
$= 15$ gals.

Quantity emptied in one minute by the two escape pipes
$= (15+10)$ gals.
$= 25$ gals.

∴ The two escape pipes would empty the cistern in $(1{,}000 \div 25)$ minutes.
$= 40$ minutes.

7. THYNER.—A, B, and C will trench a field in 12 days; B, C, and D in 14 days; C, D, and A in 15 days; and D, A, and B in 18 days. In what time will it be done (1) by all together, (2) by each separately?

A, B, C will trench in one day $\frac{1}{12}$,
B, C, D " " " $\frac{1}{14}$,
C, D, A " " " $\frac{1}{15}$,
D, A, B " " " $\frac{1}{18}$;

∴ (By addition)
3 (A, B, C, D) " " " $= \frac{105+90+84+70}{1260}$

$= \frac{349}{1260}$;

∴ A, B, C, D " " " $= \frac{349}{1260} \div 3$

$= \frac{349}{3780}$.

D will trench in one day $\frac{349}{3780} - \frac{1}{12}$

$= \frac{349-315}{3780}$

$= \frac{34}{3780}$

$= \frac{17}{1890}$;

A " " " $\frac{349}{3780} - \frac{1}{14}$

$= \frac{349-270}{3780}$

$= \frac{79}{3780}$;

B " " " $\frac{349}{3780} - \frac{1}{15}$

$= \frac{349-252}{3780}$

$= \frac{97}{3780}$;

C " " " $\frac{349}{3780} - \frac{1}{18}$

$= \frac{349-210}{3780}$

$= \frac{139}{3780}$.

∴ All will trench the field in $\frac{3780}{349}$ days
$= 10\frac{330}{349}$ days.

A " " " $\frac{3780}{79}$ days
$= 47\frac{77}{79}$ days;

B " " " $\frac{3780}{97}$ days
$= 38\frac{94}{97}$ days;

C " " " $\frac{3780}{139}$ days
$= 27\frac{87}{139}$ days;

D " " " $\frac{3780}{34}$ days
$= 111\frac{6}{17}$ days.

8. H. ASH, Lechlade.—From a sum of money I paid first $\frac{1}{3}$ of $\frac{3}{7}$ of the whole; then $\frac{3}{4}$ of what was left; and after paying a fourth of the remainder I found I had only 5s. What money had I at first?

I first paid $\frac{1}{3}$ of $\frac{3}{7}$ or $\frac{1}{7}$ of my money;

∴ I had left $\frac{6}{7}$ of my money.

I then paid $\frac{3}{4}$ of what was left;

∴ I had remaining $\frac{1}{4}$ of what was left, or $\frac{1}{4}$ of $\frac{6}{7}$, or $\frac{3}{14}$ of my money.

I then paid $\frac{1}{4}$ of the remainder;

∴ I had left $\frac{3}{4}$ of the remainder, or $\frac{3}{4}$ of $\frac{5}{21}$, or $\frac{5}{28}$ of my money.

∴ $\frac{5}{28}$ of the amount $= 5$s.
$\frac{1}{28}$ " " $= 1$s.
∴ The amount $=$ a guinea.

9. W. W. POTTER, Greens Norton.—A person invests £18,150 in the 3 per cents. at $90\frac{3}{4}$, and on their rising to 91, transfers it to the $3\frac{1}{2}$ per cents. at $97\frac{1}{2}$; what increase does he make thereby in his annual income?

£ £ £
$90\frac{3}{4}$: 18,150 :: 100 : Stock in first case
4 4

363 72,600
200
= £20,000 Stock.

Income in first case $= 3\%$ on £20,000
= £600.

£ £ £
$97\frac{1}{2}$: 91 :: 20,000 : Stock in second case
2 2 4,000

195 182
39 14
3 4,000
56,000

£18,666 13s. 4d. Stock.

Income in second case $= 3\frac{1}{2}\%$ on £18,666 13s. 4d.

£18,666 13 4
$3\frac{1}{2}$

56,000 0 0
9,333 6 8

£653·33 6 8
20

s.6·66
12

d.8·00

£653 6s. 8d.

∴ Increase in income = £653 6s. 8d. − £600
= £53 6s. 8d.

10. R. B., Northumberland.—If 2 boys and 1 man do a piece of work in 4 hours, and 2 men and 1 boy can do the same in three hours; find in what time (1) a man, (2) a boy, and (3) a man and a boy together, respectively, can do the same.

1 man and 2 boys can do the work in 4 hours,
and 2 men and 1 boy " " 3 "
∴ 1 man and 2 boys can do in one hour $\frac{1}{4}$ of the work,
and 2 men and 1 boy " " $\frac{1}{3}$ "
∴ (By addition)
3 men and 3 boys " " $\frac{1}{4}+\frac{1}{3}$ "
$= \frac{7}{12}$ "
∴ 1 man and 1 boy " " $\frac{7}{12} \div 3$ "
$= \frac{7}{36}$ "
1 man can do in 1 hour $\frac{1}{2} - \frac{7}{36}$ of the work,
$= \frac{5}{36}$ "
and 1 boy " " $\frac{1}{3} - \frac{7}{36}$ "
$= \frac{1}{18}$ "

(1) ∴ A man can do the work in $\frac{24}{3}$ hours
$= 7\frac{1}{2}$ hours.
(2) ∴ A boy ,, ,, 18 hours.
(3) ∴ A man and a boy ,, $\frac{24}{5}$ hours
$= 5\frac{1}{2}$ hours.

11. J. HOWARD, Longton.—A, B, and C enter into partnership, with capitals which are as 1 : 2 : 3. In six months A withdraws one-half of his capital, but restores it after three months more. At the end of four months from the commencement, B withdraws one-third of his capital, and two months after, C adds twice as much as B withdrew. How should a profit of £658 10s. be divided at the end of a year? (Civil Service Exam., April, 1881.)

The capitals of A, B, C = $\frac{1}{6}$, $\frac{1}{3}$, $\frac{1}{2}$ of whole capital, respectively.
∴ (Proportionately)

A's capital for the year $= (\frac{1}{6} \times 9) + (\frac{1}{12} \times 3)$
$= \frac{3}{4} + \frac{1}{4}$
$= \frac{4}{4}$.
B's ,, ,, $= (\frac{1}{3} \times 4) + (\frac{2}{3} \times 8)$
$= \frac{4}{9} + \frac{16}{9}$
$= \frac{20}{9}$.
C's ,, ,, $= (\frac{1}{2} \times 12) + (\frac{2}{3} \times 6)$
$= 6 + \frac{8}{3}$
$= \frac{26}{3}$.

$\frac{4}{4} + \frac{20}{9} + \frac{26}{3} = \frac{63 + 112 + 264}{36} = \frac{439}{36}$.

£658 10s. ÷ 439 = £1 1cs.
∴ A's share = £1 10s. × 63 = £94 10s.;
B's ,, = ,, × 112 = £168;
C's ,, = ,, × 264 = £396.

12. ANDEFFARD.—I buy a field for a thousand pounds, for which I receive £30 a year rent, which I invest as soon as received at 4 per cent. compound interest. At the end of 3 years I sell it again for £1,030. What have I lost or gained by buying the field instead of investing the purchase-money on the same terms as I did the rent?

Rent + interest at end of 2nd year = £30 + 4% on £30 + £30
= £60 + £1·2
= £61·2.
,, ,, ,, ,, 3rd ,, = £61·2 + 4% on £61·2 + £30
= £91·2 + £2·448
= £93·648
∴ Total amount = £93·648 + £30
= £123·648.

Compound interest on £1,000 for 3 years at 4% :—
Amount at end of 1st year = £1,040.
,, ,, 2nd ,, = £1,040 + 4% on £1,040
= £1,040 + £41·6
= £1,081·6.
,, ,, 3rd ,, = £1,081·6 + 4% on £1,081·6
= £1,081·6 + £43·264
= £1,124·864.
∴ Compound interest = £124·864.
∴ Loss = £124·864 − £123·648
= £1·216
= £1 4s. 3$\frac{3}{11}$d.

13. J. E. ROWLEY, Sedgley.—If goods bought in London at a guinea be exported to New York, at how many dollars should they be sold there, in order to cover all expenses; estimating the export charges to be 7½ per cent., and the sale charges 5 per cent.; the course of exchange being 6 per cent. premium for bills on London? (A dollar is worth 4s. 6d. at par.)

7½ per cent. + 5 per cent. = 12½% = $\frac{1}{8}$

∴ Net amount in dollars $= \left(\frac{21}{1} \times \frac{9}{8} \times \frac{x}{9}\right)_4$
$= \frac{21}{4}x$.

∴ The goods must be sold for $\left(\frac{21}{4} \times \frac{25}{94}x\right)$ dollars
$= \frac{525}{376}x$ dollars
= 5 dollars 58$\frac{24}{47}$ cents.

14. H. T. KNOWLTON, Southampton.—A mixture of soda and potash, dissolved in 2,540 grains of water, took up 980 grains of aqueous sulphuric acid, and the weight of the compound solution was 4,285 grains. Find how much potash and how much soda the mixture contained, assuming that the aqueous sulphuric acid united with soda in the proportion of 49 to 32, and with potash in the proportion of 49 to 48. (*Hamblin Smith.*)

Quantity of potash and soda = {4,285 − (2,540 + 980)} grains
= (4,285 − 3,520) grains
= 765 grains.
$\frac{49}{81}$ times potash + $\frac{49}{32}$ times soda = 980 grains.
$\frac{1}{81}$ of potash + $\frac{1}{32}$ of soda = 20 grains.
Multiplying by 96, Twice potash + 3 times soda = (20 × 96) grs.
= 1,920 grs;
But, potash + soda = 765 grains.
∴ Twice potash + twice soda = 1,530 grains;
∴ (By subtraction),
Soda = 390 grains.
Potash = 375 grains.

15. DISCO.—A merchant sells 72 quarters of corn at a profit of 8 per cent., and 37 quarters at a profit of 12 per cent.; if he had sold the whole at a uniform profit of 10 per cent. he would have received £2 14s. 3d. more than he actually did; what was the price he paid for the corn? (*Barnard Smith.*)

Suppose the cost price were £100 per quarter,
Then the profit would have been £(72 × 8 + 37 × 12)—
= £(576 + 444)
= £1,020.
If sold at a uniform profit of 10 per cent. the profit would have been £{(72 + 37) × 10}
= £1,090.
Difference of profits = £1,090 − £1,020
= £70.

£	£	s.	d.	£
∴ 7$\frac{1}{2}$	: 2	14	3	:: 10$\frac{1}{2}$: cost price per qr.
			10	
	27	2	6	
	£3	17	6	Ans.

Algebra.

1. T. A. MUMMERY, Folkestone.—Find the exact value of the Compound Surd :

$$\sqrt[3]{\sqrt{108}+10} - \sqrt[3]{\sqrt{108}-10}.$$

Assume $\sqrt[3]{\sqrt{108}+10} = \sqrt{x}+y$,

Then $\sqrt[3]{\sqrt{108}-10} = \sqrt{x}-y$.

By multiplication, $\sqrt[3]{108-100} = x - y^2$
$\sqrt[3]{8} = x - y^2$
$x - y^2 = 2$
$\therefore x = y^2 + 2$.

Again, $\sqrt[3]{\sqrt{108}+10} = \sqrt{x}+y$

Cubing each side, $\sqrt{108}+10 = \sqrt{x^3}+3xy+3y^2\sqrt{x}+y^3$
$\therefore y^3 + 3xy = 10$
Substituting value of x, $y^3 + 3y(y^2+2) = 10$
$y^3 + 3y^3 + 6y = 10$
$4y^3 + 6y = 10$.

This equation is satisfied by $y = 1$; hence $x = 3$.

$$\therefore \sqrt[3]{\sqrt{108}+10} - \sqrt[3]{\sqrt{108}-10}$$
$$= \sqrt{3}+1 - (\sqrt{3}-1)$$
$$= \sqrt{3}+1 - \sqrt{3}+1$$
$$= 2. \text{ Ans.}$$

2. J. FORREST, Guisbrough.—A man travels 5 miles in one day, 8 the next, 11 the next, increasing his journey regularly at the same rate; in how many days will he travel 735 miles?

This is a question in Arithmetical Progression, where a (first term) = 5, d (difference) = 3, s (sum) = 735, and n (No. of terms) is required.

$$s = \left\{2a + (n-1)d\right\}\frac{n}{2}$$
$$\therefore 735 = \left\{2 \times 5 + (n-1)3\right\} \times \frac{n}{2}$$
$$= \left\{10 + 3n - 3\right\} \times \frac{n}{2}$$

$$= \left\{ 7 + 3n \right\} \times \frac{n}{2}$$

$$1470 = 7n + 3n^2$$

$$n^2 + \frac{7n}{3} = 490$$

$$n^2 + \frac{7n}{3} + (\tfrac{7}{6})^2 = 490 + \tfrac{49}{36}$$

$$= \tfrac{17689}{36}$$

$$n + \tfrac{7}{6} = \pm \tfrac{133}{6}$$

$$n = \pm \tfrac{133}{6} - \tfrac{7}{6}$$

$$\therefore n = 21 \text{ or } -23\tfrac{1}{3}.$$

It is apparent that the negative value is inapplicable, and therefore No. of days = 21.

3. H. TRIPLETON, Chesterfield.—Divide the number a into two such parts that the sum of the quotients obtained by dividing one part by m and the other by n may be equal to b.—*Hamblin Smith.*

Let x = one part,
Then $a - x$ = other part

$$\therefore \frac{x}{m} + \frac{a-x}{n} = b$$

$$nx + am - mx = bmn$$

$$nx - mx = bmn - am$$

$$(n-m)x = (bn - a)m$$

$$\therefore x = \frac{(bn-a)m}{n-m}$$

or $\dfrac{(a-bn)m}{m-n}$ (one part).

$$\text{Other part} = a - \frac{(a-bn)m}{m-n}$$

$$= \frac{am - an - am + bmn}{m-n}$$

$$= \frac{(bm-a)n}{m-n}.$$

4. J. TIMMS, Tonbridge.—If x^2+ax+b, and x^2+cx+d, have a common measure of the form $x+e$, show that $e = \dfrac{b-d}{a-c}$

If $x+e$ measure x^2+ax+b and x^2+cx+d, it will also measure their difference;

$\therefore x+e$ will measure $x^2+ax+b-(x^2+cx+d)$,
" " " $ax - cx + b - d$,
" " " $(a-c)x + b - d$,
" " " $x + \dfrac{b-d}{a-c}$;

$$\therefore e = \frac{b-d}{a-c}.$$

Note.—Writing very good.

5. W. B, Kingston.—Transform 12345678 from the decimal to the duodecimal scale, and also to the scale of 7.

12 | 12,345,678
12 | 1,028,806... 6
12 | 85,733...10
12 | 7,144... 5
12 | 595... 4
12 | 49... 7
4... 1

$\therefore$ 12345678 in the decimal scale = 41745 t 6 in the duodecimal scale.

7 | 12,345,678
7 | 1,763,668 ..2
7 | 251,952...4
7 | 35,993...1
7 | 5,141...6
7 | 734...3
7 | 104...6
7 | 14...6
2...0

$\therefore$ 12345678 in the decimal scale = 206636142 in the scale of seven.

6. JENISA.—If $\left(\frac{1}{x} + \frac{2}{y} + \frac{1}{z}\right)^2 = \frac{(x+2y+z)^2}{xyz}$, show that either $x = z$, or $y^2 = xz$. (*Science and Art*, May, 1881.)

If $\left(\frac{1}{x} + \frac{2}{y} + \frac{1}{z}\right)^2 = \frac{(x+2y+z)^2}{xyz}$,

Then $\left(\frac{yz+2xz+xy}{xyz}\right)^2 =$ "

Then $\frac{y^2z^2+4x^2z^2+x^2y^2+4xyz^2+2xy^2z+4x^2yz}{x^2y^2z^2}$

$= \frac{x^2+4y^2+z^2+4xy+2xz+4yz}{xyz}$,

" $y^2z^2+4x^2z^2+x^2y^2+4xyz^2+2xy^2z+4x^2yz$
$= x^2z+4xyz+xz^2+4x^2yz+2xyz^2+4xyz^2$,

" $y^2z^2+2x^2z^2+x^2y^2-2xy^2z-x^2z-xz^2=0$,

" $y^2(z^2-2xz+x^2)-xz(x^2-2xz+z^2)=0$,

" $y^2(x-z)^2-xz(x-z)^2=0$;

$\therefore$ y^2 must equal xz,
or $(x-z)^2$ " 0;
if $(x-z)^2=0$, then $x=z$.
$\therefore$ $x=z$, or $y^2=xz$.

7. H. TAYLOR, Herne Hill.—Find the G.C.M. of

$8x^5+58x^4+23x^3+65x^2+17x+21$, and $x^3+6x^2+5x+84$.

$8x^5+48x^4+6x^3+6x^2+5x+84$) $8x^5+58x^4+23x^3+65x^2+17x+21$ (8

$8x^5+48x^4+48x^3+40x+672$

$10x^4+71x^3+17x^2-23x-651$) $10x^5+60x^4+60x^3+50x+840$ ($x+11$

$10x^5+71x^4+17x^3-23x^2-651x$

$-11x^4-77x^3+83x^2+701x+840$

-10

$110x^4+770x^3-830x^2-7,010x-8,400$

$110x^4+781x^3+187x^2-253x-7,161$

$-11x^3-1,017x^2-6,757x-1,239$) $110x^4+781x^3+187x^2-253x-7,161$ ($10x+9,389$

$110x^4+10,170x^3+67,570x^2+12,390x$

$-9,389x^3-67,383x^2-12,643x-7,161$

-11

$103,279x^3+784,213x^2+139,073x+778,771$

$103,279x^3+958,613x^2+63,441,473x+11,632,971$

-1333) $-8,807,400x^2-63,302,400x-11,554,200$

$4,893x^2+35,168x+6,419$

Now, $4,893x^2+35,168x+6,419$

$= (4,893x+917)(x+7)$

The two quantities are divisible by $x+7$.

$\therefore$ G.C.M. $= x+7$.

8. ENQUIRER.—A and B walk over the same ground, going out one way and coming home the other, but they start in opposite directions. A walks $3\frac{3}{4}$ miles per hour, and B walks 4 miles per hour. A wants a quarter of a mile of being half way when he meets B. Required the length of the walk.

Let x = length of walk in miles,

Then $\frac{x}{2} - \frac{1}{4}$ = distance walked by A when they meet,

And $\frac{x}{2} + \frac{1}{4}$ = " " B " "

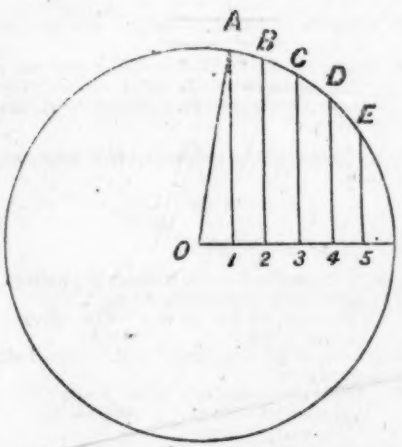
$$\therefore \left(\frac{x}{2}-\tfrac{1}{4}\right)\div 3\tfrac{1}{2}=\left(\frac{x}{2}+\tfrac{1}{4}\right)\div 4$$
$$\frac{2x-1}{4}\times\frac{4}{15}=\frac{2x+1}{4}\times\tfrac{1}{4}$$
$$\frac{2x-1}{15}=\frac{2x+1}{16}$$
$$32x-16=30x+15$$
$$32x-30x=15+16$$
$$2x=31$$
$$\therefore x=15\tfrac{1}{2}.$$

∴ Length of walk = $15\frac{1}{2}$ miles.

9. N. A. B.—Solve—
$$\sqrt{9x+1}+\sqrt{4x-3}=13.$$
$$\sqrt{9x+1}+\sqrt{4x-3}=13$$
Squaring each side, $9x+1+2\sqrt{(9x+1)(4x-3)}+4x-3=169$
$$13x-2+2\sqrt{36x^2-23x-3}=169$$
Transposing, $2\sqrt{36x^2-23x-3}=171-13x$
Squaring each side, $4(36x^2-23x-3)=29{,}241-4{,}446x+169x^2$
$$144x^2-92x-12=29{,}241-4446x+169x^2$$
Transposing, $144x^2-169x^2-92x+4.446x=29{,}241+12$
$$-25x^2+4.354x=29\,253$$
$$x^2-\frac{4.354x}{25}=-\frac{29{,}253}{25}$$
Completing the square ... $x^2-\frac{4.354x}{25}+\left(\frac{2.177}{25}\right)^2=\frac{4.739{,}220}{625}-\frac{29.253}{25}$
$$=\frac{4.739.329-731.325}{625}$$
$$=\frac{4.008\,004}{625}$$
Extracting square root, $x-\frac{2.177}{25}=\pm\frac{2.002}{25}$
$$x=\pm\frac{2.002}{25}\times\frac{2.177}{25}$$
$$\therefore x=\frac{4.179}{25}\text{ or }\frac{175}{25}=167\tfrac{4}{25}\text{ or }7.$$

Mensuration.

1. X. L. C. R.—The radius of a circle is divided into six equal parts, and at the five points of division straight lines are drawn at right angles to the radius to meet the circumference. Find the lengths of these straight lines in inches to three decimal places, that of the radius being one foot.



Each of the divisions of the radius = $\frac{1}{6}$ of 1 foot = 2 inches.

A1 = $\sqrt{12^2-2^2}$ (i. 47) = $\sqrt{140}$ = 11·832 . . . in.
B2 = $\sqrt{12^2-4^2}=\sqrt{128}$ = 11·313 . . . in.
C3 = $\sqrt{12^2-6^2}=\sqrt{108}$ = 10·392 . . . in.
D4 = $\sqrt{12^2-8^2}=\sqrt{80}$ = 8·944 . . . in.
E5 = $\sqrt{12^2-10^2}=\sqrt{44}$ = 6·633 . . . in.

2. T. J. BEYNON, Saint Clears.—A ship's hold is 99 ft. long, 40 ft. broad, and 5 ft. deep; how many bales can be stowed in it each 3 ft. 6 in. long, 2 ft. 8 in. broad, and 2 ft. 6 in. deep, leaving a gangway of 4 ft. broad?

Note.—The gangway runs round the hold.

Cubical content of hold (without gangway)
$$=\{(99-8)\times(40-8)\times 5\}\text{ cub. ft.}$$
$$=(91\times 32\times 5)\text{ cub. ft.}$$
Cubical content of a bale = $(3\frac{1}{2}\times 2\frac{2}{3}\times 2\frac{1}{2})$ cub. ft.
$$\therefore \text{No. of bales}=91\times 32\times 5\div\frac{7}{2}\times\frac{8}{3}\times\frac{5}{2}$$
$$=\frac{13\quad 16}{91\times 32\times 8\times 3}$$
$$=\underline{624}.$$

3. E. E. ATKINSON, Millom.—The sides of a rectangle are 16 and 24 feet; what breadth of border must be taken off all round that the remaining area may be 240 sq. ft.?

Let x = breadth of border in feet;
Then $(24-2x)\times(16-2x)$ = area of remaining portion in sq. ft.
$$\therefore (24-2x)\times(16-2x)=240$$
$$384-80x+4x^2=240$$
$$4x^2-80x=240-384$$
$$=-144$$
$$x^2-20x=-36$$
Completing the square, $x^2-20x+(10)^2=-36+100$
$$=64$$
Extracting square root, $x-10=\pm 8$
$$x=\pm 8+10$$
$$\therefore x=18\text{ or }2.$$

It is evident that 18 is inapplicable, therefore breadth of border = 2 feet.

Note.—As this question is solved by Algebra, it should not have been placed under Mensuration in the Examination Paper.

4. T. HESLOP, Aldoth.—Two townships, A and B, having but one church, contribute to the repairs thereof in the proportion of 4 : 5. It so happens that the church has a conical wooden spire which wants the protection of a little paint. The circumference of the spire's base is 47 feet, and the altitude is 20 yards. Now the township A paints the upper part of the spire with black paint, and the township B paints the lower part with white paint. How far from the spire's base will be the boundary between the two colours, the price of white paint being twice as great as the price of black paint?

Part to be painted by A : part to be painted by B
:: 4 × 2 : 5 × 1
:: 8 : 5.
∴ Part to be painted by A = $\frac{8}{13}$,
,, ,, ,, B = $\frac{5}{13}$.
Surface of spire = (circ. of base × slant height) ÷ 2
Diameter of base = 47ft. ÷ 3·1416
= 14·96ft.
Radius ,, = 7·48 ft.
Slant height ... = $\sqrt{(7\cdot48)^2+60^2}$
= $\sqrt{55\cdot9504+3{,}600}$
= $\sqrt{3{,}655\cdot9504}$
= 60·46ft.
∴ Surface of spire = (47 × 60·46 ÷ 2) sq. ft.
= 1,420·81 sq. ft.
∴ Surface to be painted by A = $\frac{8}{13}$ of 1,420·81 sq. feet.
= 874·34 sq. ft.
and ,, ,, ,, B = 546·47 sq. ft.

The surface to be painted by B is the surface of the frustrum of a cone, and equals the sum of the perimeters of the two ends multiplied by half the slant height.

Let p = perimeter of the upper end of the frustrum,
and let h = the slant height of the frustrum.

∴ Surface to be painted by B = $(47+p)\times\frac{h}{2}$,

and ,, ,, ,, A = $p\times\frac{60\cdot46-h}{2}$.

$$\therefore p\times\frac{60\cdot46-h}{2}=874\cdot34$$
$$(47+p)\times\frac{h}{2}=546\cdot47$$
$$60\cdot46\,p-ph=1{,}748\cdot68$$
$$47\,h+ph=1{,}092\cdot94$$

(By addition)

$$60{\cdot}46\,p + 47k = 2{,}841{\cdot}62$$
$$\therefore p = \frac{2{,}847{\cdot}62 - 47k}{60{\cdot}46}$$
$$47k + \frac{k(2{,}841{\cdot}62 - 47k)}{60{\cdot}46} = 1{,}092{\cdot}94$$
$$2{,}841{\cdot}62k + 2{,}841{\cdot}62k - 47k^2 = 66{,}079{\cdot}1524$$
$$47k^2 - 5{,}683{\cdot}24k = -66{,}079{\cdot}1524$$
$$k^2 - 120{\cdot}92k = -1{,}405{\cdot}9394$$
$$k^2 - 120{\cdot}92k + (60{\cdot}46)^2 = 3{,}655{\cdot}4116 - 1{,}405{\cdot}9394$$
$$= 2{,}249{\cdot}4722$$
$$k - 60{\cdot}46 = \pm 47{\cdot}428$$
$$k = \pm 47{\cdot}428 + 60{\cdot}46$$
$$\therefore k = 107{\cdot}888 \text{ or } 13{\cdot}032.$$

∴ Boundary will be 13·032 ... feet (on the slant height) from the base.

General.

1. W. BOOKER, Sheffield.—Your solution to Query 43 is *incorrect*. You take for granted what has to be proved.

2. D. ROWE, Dunstable.—Your solution to Query 42 is *incorrect*. You say, 'Then the fourth side of the quadrilateral will be equal to the fourth line,' without any reason for this conclusion. The correct solution is entirely different to your method.

In your solution to Query 43 you do not prove that the perpendicular lines will fall as you have drawn them, and therefore it is *imperfect*. There is a simpler method of proof.

3. W. W., Stratford-on-Avon.—You must complete your apprenticeship to be qualified as an Ex-P.T.

4. GRAMMARIAN. — 'Heavy'—Adj. qual., pos. deg., qual. the noun 'ivy-tod.'

5. G. N., Birkenhead.—Your easiest course is to get qualified as a Certificated Teacher in England. Your certificate would, we believe, stand you in good stead abroad.

6. A. D., Peckham.—The liberty of the English Press was established fully about 1780. The London printers were the first to claim the right of reporting Parliamentary debates.

7. LIBRETTO, Enfield.—We should advise you to apply to the undermentioned firms for their list of works such as you require:—

Messrs. Blackie and Son, Old Bailey, London, E.C.;
Messrs. Winsor and Newton; or to
Messrs. George Rowney and Co.

8. W. D. NICHOLAS.—The publishers of Carlyle's works are Chapman and Hall. The prices vary from 2s. a volume to £15 the set.

9. E. CROSS, Faversham.—A box, including its lid, is made of six equal square laminæ. Where is its centre of gravity when its lid is turned back through an angle of 180°? (*Science and Art*, 1881). Now, if the three laminæ forming the bottom, back, and lid be considered in the new position, it is clear that the centre of gravity of these three is the centre of the back, *i.e.*, the intersection of the diagonals.

Again, the centre of gravity of the two sides is the middle point of the line joining their centres of gravity; and the centre of the front is the intersection of its diagonals. Since these laminæ, the two sides and the front, are in the proportion of two to one, the centre of gravity of these three will be ⅔ of the distance between these centres of gravity from the front. If, now, these laminæ be taken, three and three, since their weights are equal, the centre of gravity of the whole will be midway between their centres of gravity. Now these centres of gravity are on the line joining the centres of the back and front, viz., at the centre of the back and at a point ⅓ of ⅔ or ⅓ from the front. Therefore, the distance between the centres of gravity is ⅓ of the whole line.

Wherefore, the centre of gravity of the whole is ⅓ of the distance between the centres of the back and front from the back.

Mathematics.—Mansford's Euclid, 1s.; Todhunter's Algebra, 2s. 6d.; and Trigonometry, 2s. 6d.

Mechanics.—Todhunter's Mechanics, 2s. 6d.; Galbraith and Houghton's Hydrostatics, 3s. 6d.

Physiography.—Huxley's Physiography, 7s. 6d.

10. EX P. T., Weston.—Order the syllabus through your bookseller, and then consult the nearest certificated teacher.

11. T. T. H., Sedgley.—Ross's *Elocution*, 3s. 6d. (Hughes); Taylor's *How to Compose*, 1s. (Hughes); Nicholl's *Composition*, 1s.

12. J. E. ROWLEY, Sedgley.—We should advise you to write to the following publishers for their lists:—

Messrs. Stewart and Co., Holborn Viaduct Steps, E.C.;
Messrs. Longmans, Paternoster Row, E.C.;
Messrs. G. Bell and Son, York Street, W.C.;
Messrs. Macmillan and Co., Bedford Street, W.C.; and to the Cambridge Warehouse, Paternoster Row, E.C.

13. J. W. C. A.—The word 'conynge' found in the account of a Spanish bull fight in Byron's 'Childe Harold,' Canto I., means in the sense in which it is there used 'skilful,' 'quick,' 'cunning.' It is evidently derived from the Latin *cogneo*, and may be found in the writers of the period of Renaissance, and also in the mediæval authors, especially in Chapman, Marlowe, &c.

14. R. PRYOR, Cornwall.—Thanks for correction.

15. URGENT.—Sutton's Manual, 2s.

16. LINGUIST.—Your first two sentences are incorrectly stated. The third, translated, is 'Wales the land of song.'

17. COVENTRY.—The *correct* solution (similar to yours) appeared in our last issue.

18. C. WINSCOM, Cullingworth.—No one can say.

19. C. D. M'LEAN, Baillieston.—Thanks for pointing out the error in the *Scholarship Answers*; also for your high opinion of our journal.

20. PUPIL TEACHER, Worthing.—You will see your error from the following:—

Area of ABCD ... = (120 × 80) sq. ft = 9,600 sq. ft.
" " EFGH ... = {(120 − 12) × (80 − 12)} sq. ft.
= (108 × 68) sq. ft.
= 7,344 sq. ft.
∴ Area of walk ... = (9,600 − 7,344) sq. ft.
= 2,256 sq. ft.
= 250⅔ sq. yds.

21. W. S. ROBERTSON, Aberdeen.—There are no examinations for inspectors of schools. The 'Education Code' and the 'Syllabus for the Certificate Examination,' which may be obtained through any bookseller, will give the desired information for your second query.

22. H. WALKER, Bloxwich.—Thanks. You are right.

23. W. SEYMOUR, South Shields.—Your problem resolves into an equation, for which we can see no method of solution, although we have given a great deal of time to it. Sufficient data are not given.

24. P. P.—If two oblique systems have the same origin and axis of x, then

$$x = x' + y' \sin\frac{(\omega - \omega')}{\sin\omega},$$
$$y = y'\frac{\sin\omega'}{\sin\omega};$$

ω and ω' being the angles between the axes respectively.

If two oblique systems have the same origin, then

$$x \sin\omega = x' \sin(\omega - \alpha) + y' \sin(\omega - \beta),$$
$$y \sin\omega = x' \sin\alpha + y' \sin\beta;$$

where XOX′ = α, XOY = ω, XOY′ = β. (See Todhunter's *Conic Sections*, page 85.)

In the given case, α = 0, and β = ω′;

$$\therefore x \sin\omega = x' \sin\omega + y' \sin(\omega - \omega'),$$
$$y \sin\omega = y' \sin\omega';$$

that is, $x = x' + y'\frac{(\sin\omega - \omega')}{\sin\omega}$,

$$y = y'\frac{\sin\omega'}{\sin\omega}.$$

25. EXCELSIOR.—(1) School Management (Currie's,); History (Curtis's, 5s. 6d.); Algebra (Todhunter's, 2s. 6d.); Mensuration (Elliot's, 2s.); Political Economy (Fawcett's,); Music (Sutton's, 2s.). (2) Yes.

26. J. W. W., Preston.—Euclid (Mansford's, 1s., and Exercises, 2s. 6d.; or Potts', 4s. 6d.); Algebra (Todhunter's, 2s. 6d.); Mensuration (Elliot's, 2s.); Geography (Cornwell's, 3s. 6d.); History (Curtis's, 5s. 6d.); School Management (Currie's,); French (Havet's Series).

27. C. WINSCOM, Cullingworth.—Williams's Geography of the Oceans (Philip and Son).

28. P. T., Gobanium.—Yes. The pupil teacher, having completed his apprenticeship, is free. It is well, however, in all such cases to remain, if possible, until the inspection of the school, to take the fifth (or last) year's papers, and to obtain H.M. Inspector's recommendation under Art. 60 of the Code.

29. LIBRETTO, Enfield.—Most books on harmony contain the nomenclature of intervals. These intervals are named according to the number of semitones they are apart, *together with* the alphabetical names of the respective notes between which the intervals are reckoned. It is needful to bear this latter in mind, as for example, F sharp and G flat are the same notes on the piano, but F sharp would be named an extreme sharp 4th from C (or, according to other nomenclature, a pluperfect or augmented 4th), whereas G flat would be termed an imperfect 5th from C. In the Chromatic scale the semitones are not counted inclusively, *e.g.*, from C to C sharp is one semitone, forming a minor 2nd; from C to D, two semitones, forming a major 2nd; from C to E flat, comprising three semitones, is a minor 3rd; from C to E, comprising four semitones, is a major 3rd. The intervals to which the term *perfect* is applied are the 4th, 5th, and 8th. Intervals that always require an accidental are termed Chromatic intervals, whereas Diatonic intervals may be formed in one part or other of every Diatonic scale without the aid of accidentals.

30. R. J. F.—The value of b to satisfy the *second* quantity can be easily obtained, but as this value does not satisfy the *first* quantity, you must have copied the question *incorrectly*. Please repeat your query, taking care to send it correctly.

31. E. M.—The query (No. 25) you refer to in the November part is incorrect. We calculated, as you say, 16oz. (instead of 12oz.) to the lb. Your solution by algebra is correct, but it can be easily solved by arithmetic, and if you desire the arithmetical solution it will be given.

32. L. MINER.—Show from the formulæ for sin B and sin $\frac{C}{2}$ that $B=\frac{C}{2}$, if $c^2=b(b+a)$.

$$\text{Sin } B=\frac{2}{ac}\sqrt{s(s-a)(s-b)(s-c)}$$

$$=\frac{\sqrt{2b^2c^2+2c^2a^2+2a^2b^2-a^4-b^4-c^4}}{2ac}$$

(If $c^2=b^2+ab$)

$$=\sqrt{\frac{2b^2(b^2+ab)+2a^2(b^2+ab)+2a^2b^2-a^4-b^4-(b^2+ab)^2}{4a^2c^2}}$$

$$=\sqrt{\frac{2b^4+2ab^3+2a^2b^2+2a^3b+2a^2b^2-a^4-b^4-b^4-2ab^3-a^2b^2}{4a^2(b^2+ab)}}$$

$$=\sqrt{\frac{3a^2b^2+2a^3b-a^4}{4a^2b(b+a)}}$$

$$=\sqrt{\frac{3b^2+2ab-a^2}{4b(b+a)}}$$

$$=\sqrt{\frac{3b-a}{4b}}.$$

$$\text{Sin }\frac{C}{2}=\sqrt{\frac{(s-a)(s-b)}{ab}}$$

$$=\sqrt{\frac{\frac{b+c-a}{2}\times\frac{c-b+a}{2}}{ab}}$$

$$=\sqrt{\frac{\{c+(b-a)\}\{c-(b-a)\}}{4ab}}$$

$$=\sqrt{\frac{c^2-(b-a)^2}{4ab}}$$

(If $c^2=b^2+ab$)

$$=\sqrt{\frac{b^2+ab-b^2+2ab-a^2}{4ab}}$$

$$=\sqrt{\frac{3ab-a^2}{4ab}}$$

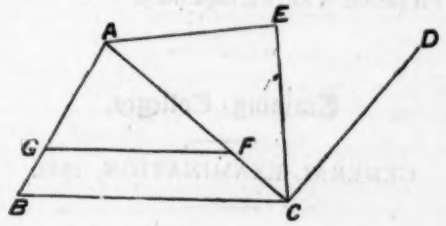
$$=\sqrt{\frac{3b-a}{4b}}$$

$$\therefore B=\frac{C}{2}.$$

Geometry.

1. A SUBSCRIBER.—Bisect a triangle by a straight line drawn parallel to one of the sides.

Let ABC be the given triangle, and let it be required to bisect it by a straight line parallel to BC.



Construction.—At C draw CD at right angles to AC, and bisect the angle ACD by the straight line CE. At A make the angle CAE equal to the angle ACE. From AC cut off AF, equal to AE, and through F draw FG parallel to BC. Then GF shall bisect the triangle ABC.

Proof.—Similar triangles are to one another in the duplicate ratio of their homologous sides (vi. 19):

$\therefore \triangle AFG:\triangle ACB::AF^2:AC^2$.

But $AF^2:AC^2$, as $AE^2:AC^2$; and $AE^2:AC^2::1:2$ (i. 47).

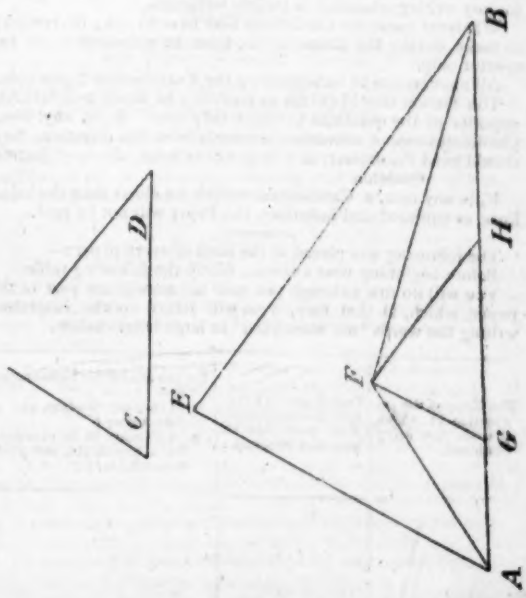
$\therefore \triangle AFG:\triangle ACB::1:2$.

Wherefore the straight line GF drawn parallel to BC bisects the triangle ABC.—Q.E.F.

2. E. AMES, Victoria Park.—Given two angles of a triangle and the perimeter to construct the triangle. (To be solved by means of the first twenty-six propositions.)

Let AB be the given perimeter, and C, D the given angles.

Construction.—At the point A make the angle BAE equal to C, and at B make the angle ABE equal to D. (I. 23.)



Bisect the angles BAE, ABE by the straight lines AF, BF, espectively. (I. 9.)

At the point F make the angle AFG equal to the angle FAG, and the angle BFH equal to the angle FBH.

Then GFH shall be the required triangle.

Proof.—Because the angle GFA = angle GAF (con.), side GF = side GA. (I.6.)

Similarly it may be proved that HF = HB. ∴ Perimeter of triangle GFH = AB, the given perimeter.

Again, the angle FGH = angles GAF, AFG, (I. 32.) ∴ angle FGH = angle EAB = angle C.

Similarly it may be proved that angle FHG = angle D. ∴ the triangle GFH has two angles equal to C, D, respectively.

Note.—It will be noticed that the thirty-second proposition is employed in the proof. If the construction were not restricted to the first twenty-six propositions, it would be preferable to draw FG, FH parallel to EA, EB, respectively.

Training Colleges.

GENERAL EXAMINATION, 1881.

NOTICE ISSUED TO CANDIDATES AS TO COPYING AND CLANDESTINE ASSISTANCE.

Candidates who are detected—

(*a*) Introducing into the Examination Room, or having about them, any book or writing, whether any one uses it or not, from which answers may be copied;

(*b*) Applying, under any circumstances whatever, to other Candidates;

(*c*) Answering, under any circumstances whatever, applications from other Candidates;

(*d*) Copying, under any circumstances whatever, one from another; or,

(*e*) Conniving at any misconduct of this kind;

will be dismissed from the Examination—will forfeit any certificate which they may previously have obtained—and will be suspended, for a period not exceeding three years, from all recognition by the Committee of Council. The plea of accident, or forgetfulness, will not be received.

Candidates must leave the blotting paper, and paper for making rough drafts, which are supplied by the Inspector, on their desks at the end of each sitting, and must bring none other into the room. The use of blotting paper for rough drafts, or for any writing whatever, is strictly forbidden.

Whatever questions Candidates may have to ask, or remarks to make, during the Examination, must be addressed to the Inspector only.

All answers are to be written on the Examination Paper only.

The answer should (as far as possible) be *begun to be written* opposite to the questions to which they refer. If, in any case, Candidates cannot conveniently comply with this direction, they should head the answer, in a large heavy hand, thus:—'Section Question '

If, in any case, a Candidate's writing be closer than the ruled lines, or confused and indistinct, the Paper will not be read.

The following was placed at the head of every paper:—

Before beginning your answers, fill up the following table.

You will do this although you may not answer any part of the paper, which, in that case, you will return to the Inspector, writing the words 'not attempted' in large letters below.

The Name of the Institution at which you are now being examined.	Your Name IN FULL, (the *Surname* first), and your Age on your last birthday.	Do you attend this Examination as— 1. A resident Student, and *of which year?* 2. A Teacher to be examined for a Certificate, and *from what School?*

FIRST YEAR.

MALE CANDIDATES.

Grammar and Composition.

Three hours allowed for this Paper.

Composition.

Every candidate *must* perform the exercise in Composition. Candidates are recommended not to take more than half-an-hour for this exercise.

Subjects for Composition.

(1) Mountain scenery.
Or (2) English sonnet writers.
Or (3) One of the incidents of the French Revolution commemorated in Wordsworth's Sonnets.
Or (4) The Lake Poets.

Grammar.

Every Candidate must do the parsing and analysis. Part of a question well answered will obtain marks.

SECTION I.

Parse the words italicised in the following passages:—

(*a*) There are *who* ask not *if* thine eye *be* on them.

(*b*) O *joy!* that in our embers is *something* that doth live.
That nature yet remembers *what* was so fugitive.

(*c*) But it will not be *long*, *ere this be thrown* aside.

(*d*) Yet despair
Touches me not, *though pensive* as a bird
Whose vernal *coverts* winter hath laid *bare*.

SECTION II.

Make a table for analysis of the following sentences:

(*a*) They a blissful course may hold
Even now, who, not unwisely bold,
Live in the spirit of this creed,
Yet seek Thy firm support according to their need.

(*b*) The homely nurse doth all she can
To make her foster-child, her inmate man,
Forget the glories he hath known,
And that imperial palace whence he came.

(*c*) What though the radiance which was once so bright
Be now for ever taken from my sight,
Though nothing can bring back the hour
Of splendour in the grass, of glory in the flower,
We will grieve not, rather find
Strength in what remains behind.

(*d*) We shall exult, if they who rule the land
Be men, who hold its many blessings dear,
Wise, upright, valiant; not a servile band,
Who are to judge of dangers which they fear,
And honour which they do not understand.

SECTION III.

(*Not more than four of these questions to be answered.*)

1. Write a brief analysis of the Ode to Duty.
2. Illustrate Wordsworth's love of Nature from his poems.
3. Give a short explanation, suitable for children, of the following passages:—
This public way streamed with the pomp of a too credulous day.
Vanguard of liberty, ye men of Kent!
She must espouse the everlasting sea.
England is a fen of stagnant water.
Plain living and high thinking are no more.
4. To what events is allusion made in the following passages?
Once did she hold the gorgeous East in fee.
Toussaint, the most unhappy man of men.
Thou, Liberty, from thine Alpine holds at length are driven.
Another mighty Empire overthrown.
Who, like Montrose, make loyalty your pride.
5. Derive *paramount, ledger, phrensy, tyrant, worldling.*
6. Give the force of the prefix in *apparel, dialogue, sympathy, forget, cataract, adverse, misgiving.*

SCHOOL MANAGEMENT.

Three hours allowed for this Paper.

Question 1A must be answered, and Question 1B must be omitted, by Students who leave the Training College to take charge of Schools after this Examination, and by Acting Teachers.

Question 1A must be omitted, and Question 1B must be answered, by all Students who are remaining in the Training College.

Not more than *nine* other questions may be answered.

Answer briefly the following questions:—

1A. (*a*) What are the advantages of a separate classification in Arithmetic?

(*b*) Why should caning on the hand be absolutely prohibited in schools?

(*c*) Why do younger boys require shorter lessons than older boys?

(*d*) In what respects is long standing in class prejudicial?

(*e*) What data are required for calculating the average yearly attendance?

(*f*) The number of failures in Reading is 17; in Writing, 19; in Arithmetic, 23; the percentage of passes is 86⅔; find the number of children presented for examination.

1B. Write full notes of a lesson on—

(*a*) The benefits of life insurance.

Or (*b*) A course of gymnastic exercises.

Or (*c*) The laws of gases which determine efficient systems of ventilating drains.

Or (*d*) The physical laws involved in the construction of a common pump.

2. Explain briefly the Phonic and Look-and-Say methods of teaching to read; and give examples of words which are more easily taught by each of these methods.

3. How would you distribute three-quarters of an hour to be employed in a reading lesson on a passage of poetry from an *unknown* author? Illustrate by a short passage, containing not less than twenty lines, taken from the author selected for Grammar in the present syllabus.

4. Give brief explanations, suitable to children, of the words italicised in the following passages, with derivations (where you can):—

His hand still *strained* the broken *brand;*
His arm was *smeared* with blood and sand:
Dragged from among the horses' feet,
With *dinted* shield and helmet beat,
The *falcon-crest* and *plumage* gone,
Can that be *haughty* Marmion?
Young Blount his armour did *unlace,*
And gazing in his *ghastly* face,
Said, by *Saint George,* he's gone!

5. Show that reproduction in exercise-books of oral lessons, or of short tales read aloud, is one of the best methods of teaching Composition to young children.

6. What rules would you give for the heights and junctions of the letters in the word "Emphasized" written in large hand? Write the word according to your rules.

7. Write out rules to be followed in the spelling of those parts of the following words which present difficulties to beginners:—conceit, receipt, colour, achieve, forego, moveable, wagon.

8. Point out the advantages and disadvantages of teaching Simple and Compound Addition together, before proceeding to other rules.

9. Write out fully the various steps to be followed in proving the rule for converting vulgar fractions into terminating decimals, and state under what conditions this is possible.

10. Write out clearly and concisely the difference between true discount and banker's discount, and give an explanation of the constant fluctuations of consols.

11. State the principal natural laws involved in a lesson on 'Wind,' and describe any simple experiments or illustrations by which you would propose to illustrate those laws.

12. Explain the difference in the nature and purpose of questions employed at the beginning, during the course, and at the close, of an oral lesson; illustrate by a lesson on 'Coffee.'

13. Show that oral teaching in most subjects requires to be supplemented by text-books and exercise-books; and name any subjects that do not require such aids, giving your reasons.

14. Describe the arrangement of windows, doors, desks, and other apparatus in a class-room designed for giving oral lessons to sixty children.

15. Explain why, in a text-book, the definition generally precedes, and in an oral lesson generally follows, the matter required for a full explanation.

British History.

Three hours allowed for this Paper.

Candidates are not to answer more than *eight* questions.

1. Write a life of St. Dunstan; and explain the terms secular and regular clergy.

2. Explain briefly the purposes for which Doomsday Book was compiled.

3. Write an account of the state of government of the country between the mouths of the Humber and Forth in the ninth century.

4. Sketch briefly the state of affairs in Scotland which gave cause for the interference of Edward I.

5. Give some account of Froissart, and of the period of history that is covered by his chronicles.

6. Explain briefly the origin of the Hundred Years' War between France and England; and enumerate, with dates, the chief events of that war.

7. Show that the reigns of the Lancastrian kings were favourable to the growth of liberty.

8. What Scottish kings were contemporary with Henry IV., Edward IV., and Henry VIII.? Write a brief life of one of those monarchs.

9. Make a table showing the grandchildren and great-grandchildren of Henry VII.

10. Discuss the justice of Elizabeth's behaviour towards Mary Queen of Scots.

11. What were the chief points at issue between Charles I. and the Long Parliament? On what points were negotiations finally broken off at the beginning of the Civil War?

12. Describe the position of the following battle-fields:—Blenheim, Dettingen, and Vittoria; name the leaders on both sides, and the result of the battle in each case.

13. Write a brief life of the younger Pitt.

14. Give some account of the Orders in Council. Explain the purposes for which they were issued, and the circumstances of their repeal.

15. Enumerate the chief events of the years 1814-15.

16. Describe the state of affairs in Greece which occasioned the Battle of Navarino; name the nations which took part in that battle, and its results.

17. What were the provisions of the Act passed for the Emancipation of slaves in 1833.

18. Explain the causes of the Crimean War, and give a brief account of the Siege of Sebastopol.

Geography.

Three hours allowed for this Paper.

Candidates must draw one of the maps in Question I., and must not answer more than *eight* other questions.

1. Draw a map of (*a*) Great Britain (showing the principal river basins); *or* (*b*) the Indian Ocean; *or* (*c*) the coast line of Africa (north of the Equator), showing the boundaries of the states or colonies bordering upon the sea.

N.B.—The map should be drawn on a scale sufficient to occupy all the blank space available. If the candidate put in and correctly number the lines of latitude and longitude it will add to the value of the exercise.

Places must not be indicated by letters or figures, referring to a list of names at the side, but *the names themselves must be inserted in the map.*

2. Compare the climate of London with that of New York and of St. Petersburg, and account generally for these differences.

3. By what trunk railways are the towns of Exeter, Shrewsbury, Dover, and Yarmouth connected with London? Give a brief description of the route traversed by one of these.

4. Show that the coast of Scotland is large in extent, but in a great measure unfit for commerce. Name the chief localities of the fishing industry of Scotland.

5. Enumerate the principal districts north of the Humber and Mersey remarkable for their natural wealth in minerals.

6. Describe briefly the positions of Upsala, Amsterdam, Lyons, Ischia, Bucharest, Moscow, Constance, and Salzburg.

7. Describe in words the courses of the Po and the Vistula, and name any incidents in history connected with those streams.

8. Enumerate the chief vegetable productions of India, and the climate required by each; name the districts chiefly devoted to their cultivation.

9. Describe the physical features of China Proper. Give a brief account of the Great Wall of China.

10. Give some account of the Lakes of Africa, and of the general directions of the rivers which rise in those lakes.

11. Classify as New England, Southern, Pacific, or Central States—Louisiana, Oregon, Iowa, Maine, California, Connecticut, Alabama, Illinois, and Michigan; and give a brief account of one of those states.

12. Enumerate the principal imports into Great Britain from Hong-Kong, Chicago, Wellington, Bombay, Jamaica, and Buenos Ayres.

13. Enumerate the rivers of South America which flow into the Atlantic Ocean, the principal towns on the banks, and the states through which they flow.

14. Name the principal groups of islands in the Malay Archipelago, and their chief articles of export; and give some account of the native races.

Euclid.

Two hours and a-half allowed for this Paper.

Candidates are not allowed to answer more than *eight* questions. Capital letters, not numbers, must be used in the diagrams. The only signs allowed are + and =. The square on AB may be written "sq. on AB," and the rectangle contained by AB and CD, "rect. AB. CD."; other abbreviations, if employed, must not be ambiguous.

1. Show that part of Euclid's definition of a square is not required. Write out the postulates. Write out all the cases of equality of triangles which are given in the First Book of Euclid.

2. If two triangles have two sides of the one equal to two sides of the other, each to each, and have also the angles contained by these sides equal to one another, they shall also have their bases or third sides equal. Two triangles ABC and DCB, equal in all respects, are on the same side of the base BC; if AD be joined, the triangle ABD is equal to the triangle DCA in all respects.

3. If a side of a triangle be produced, the exterior angle shall be greater than either of the interior opposite angles. If one of the angles of a triangle be a right angle, the three exterior angles of a triangle will be together greater than three right angles.

4. If two triangles have two angles of the one equal to two angles of the other, each to each, and the sides opposite to one of the equal angles in each equal, the third angle of the one shall be equal to the third angle of the other.

Draw a figure showing that two triangles that have two sides and an angle equal in each may have no other parts equal.

5. Every parallelogram is bisected by its diameter.

Construct a parallelogram of given area with diagonals of given length.

6. Triangles on equal bases and between equal parallels are equal to one another.

If two equal triangles stand upon equal bases, and have also another side of each equal, the triangles will have all or none of their other parts equal.

7. To a given straight line to apply a parallelogram which shall be equal to a given triangle, and have one of its angles equal to a given rectilineal angle.

On the diameter of a square construct a parallelogram equal to the square, and having one of its angles equal to one-fourth of a right angle.

8 If the square described on one of the sides of a triangle be equal to the squares described on the other two sides of it, the angle contained by those sides is a right angle.

If one of the angles of a rhombus be double of the other, show that the square on the longer diameter is three times as great as the square on a side.

9. Which of the propositions of the Second Book of Euclid may be represented algebraically by the formula $\overline{a+x}^2 = a^2 + ax + x^2$?

Draw the figure required for the proposition.

10. To describe a square that shall be equal to a given rectilineal figure.

If one of the sides of a rectangle be four times as great as the other, find the side of the square equal to the given rectangle.

11. Show that the lines bisecting the angles of a triangle meet in a point.

12. The figure formed by joining the points of bisection of the sides of a quadrilateral, taken in order, is equal to one half of the whole figure.

Arithmetic.

Two hours and a half allowed for this Paper.

Candidates are not permitted to answer more than *ten* questions.

The *solution* must be given at such length as to be intelligible to the Examiner, otherwise the answer will be considered of no value.

1. A clock is set right at 2 p.m. on Monday, December 12th; and at 6 p.m. on Friday, December 16th, it is 5 minutes slow. How much has it lost per hour?

2. A block of stone, weighing 15 tons, is composed of 4 substances, whose bulks are in the relation of 15, 13, 9, 7; while the weights of a unit of their bulks are as 6, 7, 11, 8. What is the weight of each substance in the block?

3. What will be the cost of the bricks for a wall 5 feet high, 22½ inches thick, and 35 yards long, at 15s. per 1,000, each brick being 9 inches long, 4½ inches wide, and 3 inches thick?

4. If a cubic inch of silver be worth £1 12s. 6¾d., find the value of a circular piece of money, whose diameter is 1¼ inch, and its thickness $\frac{1}{16}$ inch, taking the ratio of the circumference of a circle to its diameter as 22 to 7.

5. Arrange the fractions:—

$\frac{11}{13}$, $\frac{111}{113}$, $\frac{111}{113}$, $\frac{111}{113}$,

in their order of magnitude.

6. Explain the use of the Greatest Common Measure of two numbers or quantities; and reduce the fraction $\frac{1}{4}\frac{1}{8}\frac{1}{8}\frac{1}{7}$ to its simplest form.

7. Find the value of—

$$£1\ 1s.\ 1\tfrac{1}{4}d. \times \frac{\frac{1}{12}+\frac{1}{13}}{\frac{2}{3}+\frac{3}{11}} \times \frac{\frac{1}{18}+\frac{7}{36}}{\frac{1}{18}+\frac{3}{11}}$$

8. A grocer bought 59 cwt. 3 qrs. 4 lbs. of sugar at £1 5s. 8d. per cwt.; of this 1 cwt. 20 lbs. was unsaleable. With what profit did he sell the remainder at 3¼ per lb.?

9. If an iron casting, that weighs 5 tons 11 cwt. 9 lbs., cost £142 11s. 0¾d., what will be the weight at the same rate of a casting that costs £54 16s. 6¾d.?

10. £150 of a man's income was exempt from income-tax; and, after deducting the tax at 5d. in the £1 on the remainder from his whole income, he had £884 7s. 6d. left. What was his income?

11. Explain the term 'recurring decimal;' find the recurring decimals that represent $\frac{2}{3}$, $\frac{1}{6}$, $\frac{1}{11}$, $\frac{1}{13}$, and add the results.

12. If the weights of the same bulks of mercury and glycerine be as 11 to 1, what will be the height of a glycerine barometer when the mercurial barometer stands at 29·45 inches?

13. What sum of money put out at 3½ per cent. simple interest for 5½ years will amount to £476 10s. 0¾d.?

14. A. invests £4,625 in railway stock at 125, B. invests £4,920 in another at 120; A. receives an annual dividend at the rate of 4½ per cent., and receives £3 10s. more than B.; at what rate was the annual dividend paid to B. calculated?

15. A person sells out £3,162 10s. in 3 per cent. stock at 97½; and buys in Bank Stock at 287½, paying his broker 2s. 6d. on each £100 of stock sold or bought. He receives on his investment an April dividend of 4 per cent., and another in October of 5 per cent. How far is his income effected by the Exchange?

Algebra and Mensuration.

Three hours allowed for this Paper.

Candidates are not permitted to answer more than *nine* questions in Algebra nor more than *three* in Mensuration.

Algebra.

1. What is the meaning of $(a-b)$ where b is greater than a? How would you detect at first sight the errors in the statement $(x+a)(x+b)(x+c) = x^3 + (a+b)x + (ab+bc)x + abc$, without any previous multiplication or knowledge of the result?

2. Show that $(x+1)(x+2)(x+3)(x+4)+1 = (x^2+5x+5)^2$.

3. Prove the rule for finding the G.C.M. of two quantities; and find the G.C.M. of $6x^3 - 19x^2 + 37x - 18$ and $9x^3 - 27x^2 + 26x - 8$.

4. Divide $x^3 - y$ by $x^{\frac{1}{3}} - y^{\frac{1}{3}}$ and find the value of the quotient, when $x = 49$, $y = 625$.

5. Reduce to lowest terms—

$$\frac{x^2-x-6}{x^2-x-20} \times \frac{x^2-12x+35}{x^2+10x+16} \times \frac{x^2+12x+32}{x^2+2x-15}$$

6. Find the L.C.M. of $x^2 - a^2$, $x^3 - a^3$, $x^2 - ax + a^2$, $x^3 + a^3$, $x^2 + ax + x^2$.

7. Find the fourth root of $x^4 + 12x^3 + 54x^2 + 108x + 81$.

8. Prove that a quadratic equation can have only two roots; and form the equation whose roots are 7 and -3.

9. Solve the equations—(1) $x^2 - 2x - 15 = 0$. (2) $(x - 1)(x - 2)(x - 3) + 6 = 0$.

10. Solve the equations $x^3 - y^3 = 26$. $x - y = 2$.

11. Eliminate x from the equations $x^2 + ax + b = 0$. $x^2 + cx + d = 0$.

12. If $a : b :: b : c$;

Show that $\frac{ma^3 + b^3}{mb^3 + c^3} = \frac{a^3 + nb^3}{b^3 + nc^3}$

13. A, G, H are the arithmetical, geometrical, and harmonical means between a and b; show that $AH = G^2$ Ex. $a = 20$, $b = 35$.

14. A. is $1\frac{1}{2}$ inches taller than B., B. is $2\frac{1}{2}$ inches taller than C.; at the end of two years each has grown two inches, and the sum of their heights at that time is to the sum of their heights two years before in the ratio 317 : 305; find their original heights.

15. A man and his family consume 5 loves of bread weekly; if his wages were raised one-fortieth and the price of bread were raised one quarter, he would gain twopence weekly; but if his wages were diminished one-twentieth and the price of bread fell one-third, he would lose tenpence; find his weekly wages and the price of each loaf of bread.

Mensuration.

(The answers need not be carried beyond two places of decimals.)

1. The depth of the annual rainfall A is $22\frac{1}{2}$ inches; find the number of tons of water which fall annually upon a rectangular space of 24 chains long and 15 chains broad, a cubic foot of water weighing 1,000 oz.

2. A chain measure is short by one inch in each chain, find in acres the error committed in estimating the area of a rectangle 511 yards long, and 365 yards broad.

3. The areas of a hexagon and of the equilateral triangle formed by joining alternate angles of the hexagon are together equal to $\sqrt{3888}$ feet; find a side of the hexagon.

4. A quadrilateral is formed by two isosceles triangles on opposite sides of a common base; show that the area of the parallelogram formed by joining the bisections of the sides of the quadrilateral taken in order is invariable, if the distance between the vertices of the triangles are invariable.

SECOND YEAR.

MALE CANDIDATES.

SHAKESPEARE'S *Coriolanus* and BACON'S *Essays*.

Three hours allowed for this Paper.

Composition.

Every candidate *must* perform the exercise in composition. It is recommended that not more than *half an hour* be devoted to this exercise.

Write in plain prose a short essay on:—(1.) The Patrician Order at Rome. *Or* (2.) The date of the play of Coriolanus from internal evidence. *Or* (3.) The revolution in scientific method, introduced by Bacon. *Or* (4.) The progress of some branch of science in the present century.

Grammar.

Candidates may answer the whole of Section I., and *four* in each of the other subjects.

Marks will be obtained by answering well part of a question.

SECTION I.

Write in simple prose, and without any more amplifications than the sense requires, the following passages:—

(*a*)

I have been
The book of his good acts, whence men have read
His fame unparallel'd, haply amplified;
For I have ever verified my friends,
Of whom he's chief, with all the size that verity
Would without lapsing suffer; nay, sometimes,
Like to a bowl upon a subtle ground,
I have tumbled past the throw, and in his praise
Have almost stamped the leasing.

(*b*)

His sword, death's stamp
Where it did mark, it took; from face to foot
He was a thing of blood, whose every motion
Was timed with dying cries. Alone he entered
The mortal gate of the city, which he painted
With shunless destiny, aidless came off
And with a sudden reinforcement struck
Corioli like a planet. Now all's his:
When by and by the din of war 'gan pierce
His ready sense: then straight his doubled spirit
Requickened what in flesh was fatigate.

(*c*) To apply oneself to others is good, so it be with demonstration, that a man doth it upon regard and not upon facility. It is a good precept generally in seconding another, yet to add somewhat of one's own; as if you will grant his opinion, let it be with some distinction; if you will follow his motions, let it be with conditions; if you allow his counsel, let it be with alleging farther reasons. Men had need beware how they be too perfect in compliments, for be they never so sufficient otherwise, their enviers will be sure to give them that attribute to the disadvantage of their greater virtues. It is loss also in business to be too full of respects or to be too curious in observing times and opportunities.

SECTION II.

1. Derive *verdict, alarum, prerogative, century, sithence, caparison, godden, malkin, jet, anon.*

2. Comment on the following:—I cannot speak him home, the cranks and offices of men, him vi e that was your garland, he will not spare to gird the gods, his brows bound with oak, irons of a doit, the hospitable canon, Amazonian chin, well might they tent themselves with death.

3. Explain the metaphors in—that's off, this had touched his spirit, the cockle of rebellion, vail your ignorance, this is clean kam, bolted language, friends of noble touch, lots to blanks, a jack guardant, standing every flaw.

4. In what sense, differing from their modern usage, were the following words employed by Shakespeare—*virtue, censure, sensible, humours, complexion, affect, temperance, fond, particular, judicious.*

5. Explain the prefix in *an-hungry, bestrid, allow, perfidious, avoid, surname, entertain, surcease, sedition, malign.*

6. Explain the peculiarities in the grammatical construction of

Whose course will on the way it takes.
Rather than fool it so.
My armed knees who bowed but in my stirrup's bend.

7. Write a brief summary of Volumnia's pleading with her son for Rome.

SECTION III.

1. Write a brief abstract of the Essay on Studies.

2. Give Bacon's rules for the regimen of health.

3. Illustrate from history the truth of the following sayings—
Plantations are amongst ancient primitive and heroical works.
Upon the breaking of a great empire you may be sure to have wars.
The lower and weaker faction is the stronger in conjunction.

4. Explain briefly the following aphorisms—
Ordinary expenses ought to be limited by a man's estate. Suspicions among thoughts are like bats among birds.

5. Give the modern form of the words disadvantageable, ambassage, spials, avoidances, discontent (adj.), theologues, passable; and account for the disuse of these forms.

6. Give the meaning in the time of Bacon of advancement, composition, merely, to attend arms, estate, circumstance, obnoxious, bravery, decent, undertaker, deprave.

7. Distinguish jus suffragii and jus commercii, jus dicere and jus dare, logic and rhetoric, honour and reputation, custom and habit.

8. Translate with brief explanations—octogesimus octavus mirabilius, annus, abeunt studia in mores, Cæsarem portas et fortunas ejus.

9. Complete the following—'Men's thoughts are much according to————; their discourses and speeches according to————; but their deeds————.'

'Reading maketh a full man, etc.'

School Management.

Two hours allowed for this Paper.

The Questions on pages 1 and 4 must not be omitted by any candidate.

Not more than *seven* other questions may be answered.

1. Answer briefly the following questions:—

(*a*) What are the advantages of a separate classification in arithmetic?

(*b*) Why should caning on the hand be absolutely prohibited in schools?

(*c*) Why do younger boys require shorter lessons than older boys?

(*d*) In what respects is long standing in class prejudicial?

(*e*) What data are required for calculating the average daily attendance throughout the year?

(*f*) The number of failures to pass in reading is 17, in writing 19, in arithmetic 23; the percentage of passes is 86⅔; what is the number of children presented for examination?

2. Make out that part of a week's time-table for an upper class which would include the lessons given in Arithmetic, Geography, and Grammar, and give reasons for the length of lessons and the times selected.

3. Apply to a lesson on Moods the principle that in Grammar no rule should be given without the inquiry which gives rise to the rule.

4. Show and illustrate, by a sketch map of the neighbourhood of some school, the advantages to be gained in the early stages of Geography by the study of an accurate plan.

5. Before committing a passage of poetry to memory what preparation is required for a senior class? Apply your method to a passage from the author you have been studying for Grammar according to the present syllabus.

6. With which of the sciences is Physical Geography closely connected? Illustrate this connection in the case of one of the sciences you have named.

7. Give examples from some language you have studied to show that the study of a foreign language increases a teacher's knowledge of his mother tongue?

8. Show the peculiar value of object lessons in increasing a child's stock of words, and illustrate your statement by the new terms required for an object lesson on 'Iron.'

9. Give a passage from the author you have been studying for Grammar to exemplify the difficulty of paraphrasing an involved passage in exact synonyms.

10. What precautions does Locke suggest to preserve children from unreasonable timorousness?

11. Illustrate by a brief lesson on 'Honesty' the most effectual methods of enforcing moral truths on young children.

12. Detail some of the methods by which a healthy appetite for knowledge may be encouraged in children.

13. What rules would you lay down for checking the first signs of deceitfulness in the character of a child?

14. Write an essay on—

(*a*) The denying ourselves the satisfaction of our own desires where reason does not authorise them.

Or (*b*) The allowing liberty to children in their recreations.

Or (*c*) The use and abuse of bodily chastisement.

British History.

Two hours and a half allowed for this Paper.

Candidates are not permitted to answer more than *eight* questions.

1. Relate the circumstances which gave rise to the Septennial Act, and discuss the assertion that the passing of that Act was an usurpation of the rights of the people.

2. Name the chief financial proposals of Walpole, and explain how they were frustrated in the House of Commons.

3. Sketch briefly the campaign of Charles Edward in 1745.

4. Write a brief life of some distinguished Scotchman who flourished in the 18th century.

5. Give some account of the policy and measures of the twelve years' ministry of Lord North.

6. Describe the position of Bunker's Hill, Fontenoy, and Salamanca; and state the leaders on both sides, and the result of the battle in each case.

7. Relate the circumstances which gave rise to the Gordon Riots, and describe the behaviour of the authorities and of the king on that occasion.

8. Write a short account of the career of Hyder Ali.

9. Describe the influence of the French Revolution upon the state of English parties.

10. Give some account of Pitt's policy towards Ireland.

11. Describe the state of Ireland in the years 1795–96.

12. Sketch briefly the campaign in Spain which closed with the battle of Corunna.

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